THE PRACTICAL PHOTOGRAPHER

(LIBRARY SERIES)

EDITED BY REV. F. C. LAMBERT, M.A.

NUMBER 29.

The Pictorial Work of
A. H. Blake.

Telephotography for Beginners.

Landscape,
Architecture,
Portraiture,
Etc.

50 Illustrations and Diagrams.

PRICE 1/- NET.

HODDER AND STOUGHTON,
27, PATERNOSTER ROW, E.C.

February, 1906.

The Practical Photographer.

Library Series. **Telephotography.** **No. 29.**

Principal Contents.

Illustrations.

Editorial and other Notes.

Our next number (ready March 1st, 1906), will deal with the important subject of **Photographic Chemistry for Beginners** in an eminently simple and practical manner. Numerous simple experiments will be described.

This number will also contain several reproductions of the choice work of **Mr. Ward Muir.**

Other numbers now in active preparation will deal with **Gaslight Papers. Pinhole Photography. Curiosities of Photography. Oil Printing. Iron Printing. Ozotype. Stereoscopic Photography. Finishing the Print. Copying. Trichromatic Photography. Minor Printing Processes. Photogravure. Photo Ceramics. Photographic Societies, Meetings, Libraries, Exhibitions. Photography for the Press and Commercial Purposes. Microphotography. Pictorial Composition** (2nd part). **Portraiture** (2nd part), etc.

Important Announcement.

We have in contemplation several important developments and new features in connection with *The Practical Photographer.*

We hope to give an explicit account of these matters in our next number.

Criticism of Prints.

It is our desire to make the criticism of prints a special feature in our pages. The Editor gives his personal careful attention to this matter, and aims at making every criticism a practical, interesting, and instructive object-lesson. By paying attention to the hints thus given, often a poor print may be improved and a good print followed by one still better. In order to encourage readers to take great care in the preparation of the prints they send us, we offer **Fifteen Shillings in Prizes** for the best three, four, five, or six prints sent in each month. The winning prints will not be returned. (See Coupon).

General Notices.

1. It is particularly requested that any errors in the spelling of **Award Winners' names** should be notified to the Editor immediately they are observed.

2. Will contributors to our various competitions kindly refrain from sending *under one cover* prints for *different* competitions? This not only gives us considerable trouble, but involves the risk of the various pictures not being properly entered for the competition for which they are intended. It is far better for all concerned to send each lot of prints in separate parcels.

3. Will competitors please notice that the latest date for receiving prints for our competitions is that given on the coupon, and that we *cannot admit late arrivals?*

4. Will competitors please bear in mind (1) that the judging and criticism cannot be done until after the closing date of the competition. (2) that we go to press before the 25th of the month, and (3) that the criticism of a large number of prints takes considerable time?

5. In response to numerous requests from our correspondents we have pleasure to announce that we will do our best as far as space permits to reply to queries of a photographic nature. Will querists please (1) write plainly, (2) on one side of the paper, (3) as briefly as is consistent with clearness, and (4) give us the indulgence of their kind patience? *(Vide* Coupon).

THE PRACTICAL PHOTOGRAPHER. COUPON No. 70.

Telephotography Competition.

Name

Address

WRITE LEGIBLY.

This Coupon Expires May 15th, 1906.

Telephotography Competition.

N.B.—A Special Competition for all. See below.

Silver and Bronze Plaques, and Certificates will be placed at the disposal of the Judges.

1. In order that all our readers may enter this competition we are willing to apply the term Telephotography in a very wide and elastic manner, so that those who do not possess telephoto lenses of the usual kind may not be debarred.
2. The prints must be submitted in pairs, and the scale, size of image, or degree of magnification in one print must not be less than double that of the other.
3. Each competitor may submit one or two (but not more) pairs of prints.
4. The prints must be made by contact. Enlarged prints or contact prints from enlarged negatives made from small negatives are debarred.
5. Both negatives of a pair must be made from the same standpoint.
6. Competitors may use a telephoto lens, opera glass, telescope, magnifiers, ordinary lenses of different focal lengths, pinhole, or any other optical means they please for the production of their negatives.
7. Each print must bear on the back of the mount the title, name and address of the producer, and full details as to date, plate, lens, stop, exposure of the negative, and **printing procedure.**
8. Marks will be given for Technical and Pictorial quality. The mounting and titling will also be taken into account.
9. The Editor reserves the right to reproduce *any* prints sent in to this competition.
10. The Winning Prints will *not* be returned. Others will be returned, together with a brief criticism, if a stamped and addressed envelope or label be sent **with the prints.**
11. Prints must reach us not later than **May 15th, 1906,** addressed:—

The Editor of *The Practical Photographer*
(Telephoto Competition),
27, Paternoster Row, London, E.C.

Pictorial Printing Competition. Awards:

We must confess that this competition has not quite come up to our hopes and expectations. Many of the competitors failed to grasp the special point of the event. Some sent only one print, from which it was not possible to guess how much printing control had been exercised. Others made different, but equally futile, departures. The Silver Plaque is withheld, as no one entry entirely satisfied the judges. A bronze is assigned to W. J. Appleby for a skilful example of combination work which we hope to reproduce, and B. Schön well deserves the Certificate assigned to him by the Judges.

This Coupon Expires February 28th, 1906.

THE PRACTICAL PHOTOGRAPHER. COUPON No. 69.

Prints for Criticism (or Queries).

RULES.

1. Write legibly, on one side of the paper only.
2. Put your name, address, and a number on the back of each print, and enclose this coupon.
3. Do not send more than three prints with one coupon.
4. State the *Month*, *Hour*, *Light*, *Plate Speed*, *Stop*, *Exposure*, *Developer*, *Printing and Toning* process employed.
5. If prints are to be returned, a stamped and addressed label or envelope *must* be sent **with the prints.**
6. The Editor reserves the right of reproducing any print sent in for criticism.
7. Prints should be addressed:—THE EDITOR OF *The Practical Photographer* (Print Criticism), 27, PATERNOSTER ROW, LONDON, E.C.

Print Criticisms. Awards:

We are very glad to observe that among the prints sent in during December there was no falliug off in the general quality, despite the dark days and Xmastide counter attractions. We are also pleased to note the prints sent in by several workers of comparatively short experience are showing very healthy signs of steady progress. From the many kind letters we are constantly receiving we are well satisfied to think that our criticism hints are found helpful and encouraging.

The following are the awards for the month:—A. E. Burnett, "Summer Sunshine"; R. Low, "Profile Study"; J. Walton, "Woodland Study"; F. E. Tinker, "A Peep through Winfield"; J. R. Richardson, "When evening draws nigh"; J. Perrin, "The Portrait Painter." Highly commended:—Miss Walker, C. Drake, G. H. Saunders, J. C. Stevenson, E. J. Brooking, Geo. Hildrey.

Beginners' Junior Salon. Awards:

We have no hesitation in complimenting every one of the competitors in this event, and are free to confess that the average quality of the work was quite an agreeable surprise. The somewhat exceptionally long list of Certificates and Highly Commended will help to explain the difficulty of making the final selection for the three awards. We venture the prophecy that a goodly number of our competitors will ere long be the medal winners.

Silver Plaque: F. A. Tucker, "Binding the Wheel."

Bronze Plaque: W. A. Bagnall, "They grew in Beauty."

Extra Bronze Plaque: O. C. Wilmot, "Old Age Pensioner."

Certificates: John B. Wright, "North Transept, Winchester"; V. R. Cunningham, "Eventide"; John Walton, "Bridlington"; John Hinde, "By Raby Mere"; Arthur Turner, "Kitchen Study"; James C. Duncan, "A Hazy Morning"; W. H. G. Alston, "November"; H. Johnston, "In Epping Forest"; F. H. Cliffe, "Portrait"; Mrs. A. N. Wallington, "Chrysanthemums"; G. Andreas Achenbach, "A Brahmin Girl"; Albert W. Davis, "When the sun sets the fisherman's work begins"; J. P. Cave, "Beechwoods"; F. E. Tinker, "Evening on the Mersey."

Highly Commended: M. W. Jones, Rev. J. Larder, Arthur G. Musted, J. C. Stevenson, D. G. Collins, C. W. Colthrup, Miss C. Mason, Mrs. Brooking, Miss Shaw, J. T. Hill, C. W. F. Thomas, A. Cohen.

Fig. 1 (p. 3). A. H. Blake.

REFLECTIONS.

THE PRACTICAL PHOTOGRAPHER.

Library Series. **No. 29.**

The Pictorial Work of A. H. Blake.

By THE EDITOR.

MR. A. H. BLAKE'S pictorial work comes before us with a two-fold interest. For not only is he a maker of very charming pictures, but he is also a well-known writer on matters technical as well as pictorial. This combination of powers is particularly helpful to the worker who really wants to learn something from the doings of others; and it is not a little unfortunate that so few picture makers are able to talk about their work in an informative manner.

Mr. Blake's acquaintance with photography only goes back for a space of about ten years, but in that time he has covered a fairly wide field of subjects and treated them in a variety of styles.

Doubtless his fondness for such outdoor sports as fishing, shooting and cycling has fostered his general love of nature, and the added studies of botany and geology have played their part also in quickening observation and promoted the reasoning of cause and effect. Browning and Tennyson are his chief poets, and among his favourite painters—too many to mention—are several whose works are of the impressionistic school, Whistler, of course, coming in for special mention. Among the weaker features of photography as an art method he places first and foremost that lack of sufficient scope for

the play of imagination which sooner or later most photographers experience. Then again there is the want of spontaniety in design and balance. "By this I mean there springs up on seeing the scene the feeling that such a treatment, such an arrangement will give design and balance. Then the camera comes and our distance is dwarfed, there is little power of emphasizing this or that to get effect and the spontaniety of balance is lost. We all recognise, also, that the fatal facility of photography leads to a great preponderance of worthless work."

Among the strong points in favour of photography we find he fully recognises that "it puts a power of expression into the hands of thousands who have not the time or money to go through a training with pencil and brush. Photography has had in this way a vast effect for good in opening the eyes of many to the beauty that is around them and also helped them to understand the beauty of the painter-artist's work. On the other hand there is the danger of a cheap and easy process, reminding us of the old saw that what is easily done is seldom worth much."

He acutely observes that among the more common faults of much present-day photography is a lack of design. "So few photographers look at the pattern of things before taking them. It is an excellent plan to carry a sketch book into the field and make it a practice to reduce to line and form, light and shade, the contemplated subject before making the exposure. In this way one gets at the heart of things, and can then see if the design, pattern, composition is suitable to the feeling of the subject and is also beautiful in itself."

"Then there is a lack of imagination, *i.e.*, not seeing the essence of the scene, but allowing the attention to be distracted by prettiness, detail, etc., *i.e.*, not grasping the essentials of the picture and rigorously suppressing all else as far as possible. There is often a fatal want of accuracy of truth of tone." Our younger readers would do well to take the foregoing quotations well to heart and remember that among the essentials of pictorial work of a

high order we must have truth of tone, good design and concentration of interest.

Mr. Blake, like all other progressive workers, has passed through various phases, and we have thought it would be of considerable interest to our readers to show examples of his early as well as his later works. As regards technicalities we find him at one time working with a 15×12 camera in the field, at another with a modest quarter-plate hand camera in the streets. When conditions are favourable he prefers to do his large work direct, but for fleeting effects the hand camera is used. Platinotype is his favourite printing process. But from the small negatives bromide enlargements are made and a rough surface paper used as an aid in breaking up detail. Among his favourite effects are those of sunlight through dark spaces or falling on light spaces, but grey days with their tender and subtle effects are greatly valued. He has a special affection for the lazy riverside meadow land scenery that we are accustomed to associate with the paintings of Constable.

Fig. 1. **"Reflections."** The wonderful play of light and shade, the variety of coloured sombre greys, the weird forms and general breadth of effect which a moisture-laden atmosphere and wet pavement afford, have long been at once the ambition and despair of painter and photographer. Familiar scenes take on appearances that make us wonder where we are. Mr. Blake's rendering of his subject is full of suggestion aud shows his strong leaning towards impressionism.

Fig. 2. **"Canal Side."** Mr. Blake very truly observes in a long and interesting letter to the present writer, that London, like other large towns, abounds with pictorial matter, and only needs an observant and sympathetic attention to find unlimited material. At first glance the beginner may be inclined to pass this picture over, thinking only of the homely, work-a-day nature of the scene. But the more advanced worker will not need telling that the charm of a story is not in the sensation of its incidents, but rather in the way the homely

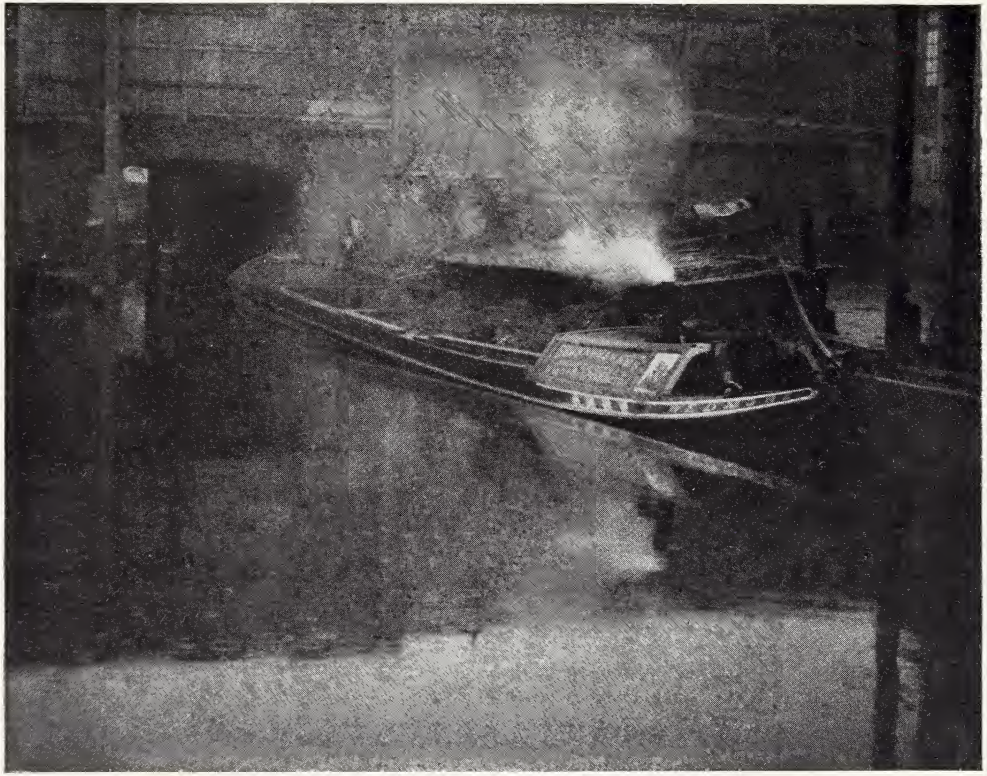
incident and scene is observed and recorded. This picture is an able and valuable lesson in tone rendering.

Fig. 3. "**The Student**," himself an old edition among old editions, speaks to us of quiet hours amid great thoughts, where plain living and high thinking fosters that fine, but exceedingly rare, scholarship which was content to give a long life to the making of one book. The artist is doubtless well aware that this picture might be here and there modified to advantage, yet as it now stands it has a quiet dignity and direct force which grows as one gets to know it better. And let us here say that this is a valuable quality not often found in photographic pictures.

Fig. 4. "**The Gleam.**" Here we have a bold and vigorous treatment of a simple, yet picturesque subject. The style of treatment is perhaps a little too dramatic. Yet the rugged nature of the scene justifies a forceful handling. The broad concentration of the lights and shades conveys a valuable lesson.

Fig. 5. "**Good News.**" An example of the artist's earlier style. In pictures of this kind the interest is more dependent on the incident depicted than the artist's manner of treating his subject. Genre work of this kind is a strong feature in English art, and some of the foremost painters of early as well as present-day times have built their reputation on work of this character. This is a good example of its kind, but is somewhat lacking in that desirable quality of concentration which Mr. Blake has rightly learned to value highly. The painter critic would say that this picture was "too busy all over itself." The lights and shades are very strongly rendered.

Fig. 6. "**The Miller's Man.**" Here we have an excellent example of concentration of effect. Picturesque though the subject is, yet the pictorial success does not depend so much on this picturesqueness as upon the chiaroscuro, the distribution and



CANAL SIDE

Fig. 2 (p. 3). A. H. Blake.

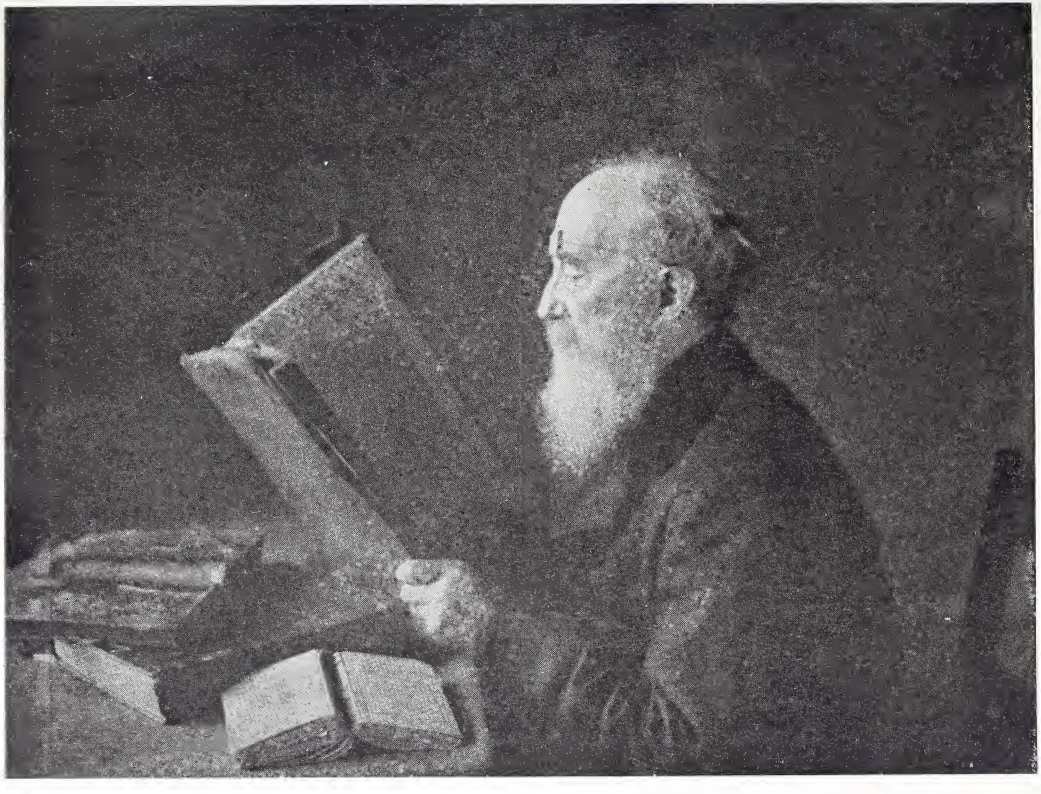


Fig. 3 (p. 4).

A. H. Blake.

The Student.

balance of light and shade, the exclusion of non-essentials and harmony of the whole scene, and the sympathetic way in which the subject has been handled.

Fig. 7. **"The Forge."** A subject often attempted by the photographer, but not often with as much success as we have here before us. Strong light and shade effects—a blending of day and artificial light—call for careful technique as well as a nice pictorial discrimination. This is one of the many problems where the painter has a great advantage over the monochrome camera-man. The student should bear in mind that strong contrast effects are not obtained by black and white means, but by a long scale of gradation and the contrasting of the extreme end of the scale.

Fig. 8. **"God's Acre."** In this composition there is a peaceful and harmonious atmosphere which has a subtle charm of its own and well accords to this garden of sleep the suggestion of the larger hope in the great beyond. The ripening sunshine, breaking in among the shadowy arms of the over-spreading trees, tells of those here sown who are biding in quietness until the Master Harvestman shall gather in his own.

Our readers, if but moderately observant, can hardly fail to learn many useful lessons from the several examples herewith reproduced.

And we join with them in offering to Mr. Blake our hearty and cordial thanks, not only for placing at our disposal a folio of prints (which made us regret how limited was our available space), but also for sending us a long and interesting letter. From this we have ventured to make several lengthy quotations, because it is always a matter of special interest to have the personally expressed opinion of one so well accustomed to put into a few simple words such thoughts and ideas as accompany the making of pictures. The man who *knows* is he who not only knows what he thinks, but also knows what others think.

Easy Introduction to Telephotography.

IN the minds of not a few photographers there is something rather puzzling, not to say mysterious, about the nature and action of a telephoto lens. We venture the opinion that if those of our readers who do not feel quite clear about the matter will be good enough to repeat a few quite simple experiments hereinafter described, they will be agreeably surprised to find the matter is really very much simpler and more understandable than they imagined. But we must warn the reader against being satisfied with *reading* a description of our experiments. For if he wants to get a real grip of the matter that will at once tell him what to do when photographing with a telephoto combination, he must actually follow us step by step in our experiments, so that when the time comes for negative making he will not need to stop and put on his puzzling cap or refer to his notebook.

Will the reader kindly allow us to assume for the moment that he knows nothing whatever about the subject, so that we may rapidly review by experiment a few of the elementary and fundamental principles?

The practice of telephotography is commonly, but quite wrongly, thought to be difficult. But any difficulties there may be are easily overcome by a *very* modest expenditure of care and attention, such as is fully set forth in the following pages

There is also an idea abroad that the telephoto lens is chiefly useful in dealing with distant mountains or architectural subjects. While its use in these domains is evident enough, it should also be said that it is equally valuable in portraiture, animal studies, middle distance landscape and many other everyday kinds of photography. As most of the illustrations hitherto put forth to show the application of telephotogrophy are of an

architectural kind, we have thought it would be an acceptable variation to give the preference to other subjects in these pages.

One of the commonest of all questions regarding the use of the telephoto lens is "*What is the difference between enlarging a small piece of a negative taken with an ordinary lens, and taking the same small bit of subject on a large scale by means of a telephoto combination?*"

The answer is that the difference is chiefly one of granularity and extra trouble. By way of illustration, let us suppose the size of the silver grains to average $\frac{1}{1000}$ part of an inch in diameter in the case of the small scale negative which is about to be enlarged. If this be enlarged, say, 7 diameters, the grains are also enlarged from $\frac{1}{1000}$ inch to, say, $\frac{1}{140}$ inch, and there is a good deal of difference between a thing enlarged 7 times and its original size. But in the telephoto negative the grains would still be only $\frac{1}{1000}$ inch. We are not definitely saying that this is the actual size of the grains in a negative film. For, in fact, they vary very greatly according to several circumstances. But an ordinary pocket magnifier will usually reveal the fact that their size is a matter which cannot be ignored when making enlargements.

(1). In a darkened room, at one end of a dining table, place a lighted candle A. About the middle of the table fix up (with the aid of one or two books) a large sheet of thin card in which has been pierced a hole with a large-sized darning needle, B. This hole should be so arranged that when the card is *in situ* the hole is at or about the same height above the table as is the candle flame.

Flames..... Pinhole..... Screen.....
A. B. C.

In a similar manner fix up a small piece of the whitest card, C, you can obtain and arrange matters so that B is about midway between A and C. If the pinhole-bearing card is fairly large it will shield C and so we shall get a pinhole-formed image of the flame A on the screen C. It is, of course, not practical to measure the size of such a small, dim and fuzzy-edged image, but we can

put two candles side by side and measure the distance between their centres and use this as a standard of size. If we put our two candles 3 inches apart at one end of the table A, our card screen at the other end C, and the pinhole-bearing card midway between the candles and their images, we shall be able to make a rough but sufficiently accurate measurement to show us that under the above conditions the distance between the flames is equal to the distance between their images. That is to say that when the pinhole is midway between the object and image the size of the image is equal to the size of the object. But as the light forming the image has to pass through a small hole the brightness of the image is very much less than the brightness of the original object, *i.e.*, the candle flame. Moreover, the naked candle flame is sending light to various parts of the room which in part finds its way to our screen C, and this makes it all the more difficult to see the image. But we can greatly improve matters, either by enclosing the candle in a large box which has a cardboard front with a hole only a little larger than the candle flame and just in front of the flame, or better still by using a large camera and ground glass and replacing the lens by a piece of card in which the pinhole is made.

Let us now take a strip of thin wood or piece of stiff stout card, say 12 inches in length and about 2 inches wide; towards the ends make two pencil marks just ten inches apart. Take two candles of equal size and length, light them and let two or three drops of melted wax fall on one of the pencil marks, and at once bring down the flat end of the candle so that its centre is just over the pencil mark. Repeat with the other candle. The melted wax on setting will hold the candle firmly. The centre of the two candles should now be just ten inches apart, so that the tips of their flames should also be ten inches from each other. We have now two small bright objects at a fixed and known distance apart which will be very useful for our next two or three experiments. Now with the two candle flames ten inches apart let us repeat our first experiment. We are no longer concerned with

Fig. 4 (p. 4).

A. H. Blake.

Fig 5 (p. 4).

A. H. Blake.

Good News.

the size of one candle flame, but only the distance between the tips or centres of two flames. Now lay a piece of cotton *o m n r* straight down the centre of the table.

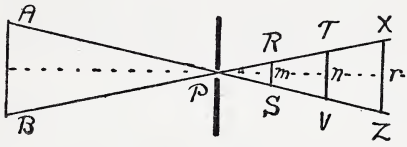


Fig. 26.

Near one end of the table and at equal distances from the cotton, put A & B, the two candle flames, ten inches apart. About one-third or mid-way down the table set up the pinhole-bearing card so that the pinhole P is over the piece of cotton *o m*. Now take a fairly long strip of card and holding this near the end of the table and at right angles to the cotton line *o r*, arrange matters so that the pinhole formed images of A, B, are received at Z and X on the strip of white card. Mark the point *r* where the card screen crosses the cotton line and also measure the distance between the tips or centres of the two flame images X and Z.

Now divide the distance Pr into three equal parts at *m* and *r*. Then bring up the card screen to *n* and note that the distance between the two candle flame images has diminished. Measure this distance T V. If due care has been taken it will be found that T V is $\frac{2}{3}$ of X Z. Then bring the card screen to *m* when we shall in similar manner find that R S is now $\frac{1}{2}$ T V, *i.e.* $\frac{1}{3}$ X Z. A glance at the figure will show that we can comprehensively sum up our results by saying that when the objects A B, and pinhole P are at a fixed distance apart the size of the image RS, TV, XZ, etc., is proportional to the distance of the image screen from P, *viz.*, proportional to Pm, Pn, Pr. We shall shortly find this simple principle of great practical importance in our application of the telephoto lens.

2. Next let us fix our card screen at the end of the table opposite to the two candle flames. Then bring the pinhole card three inches from the screen and note the distance HK between the two images (fig. 27). Then move the pinhole away to some

definite multiple of three inches, say six times or 18 inches from the screen and again measure the distance apart. We shall now find that the size of our image, *i.e.*, distance apart of candle flame images is not strictly proportional to the distance between the pinhole and screen, but also depends upon the distance between the pinhole and object.

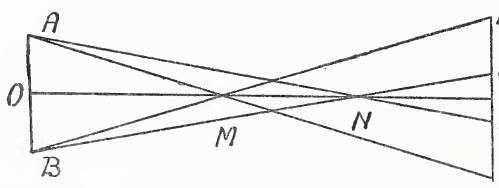


Fig. 27.

The formula

$$\frac{EF}{HK} = \frac{RM.ON}{RN.OM}$$ gives us the proportion.

By way of example, suppose the length of table to be only 4 feet, *i.e.*, OR=48 inches. Then with the pinhole at 3 and at 18 inches, as above supposed, the proportion of EF to HK would be 9 to 1 and not 6 to 1, as we might have supposed. But if our table be 8 feet long the proportion is about $7\frac{1}{2}$ to 1. And by further increasing the distance of the object without altering the distances between image and pinhole, we shall find at 20 feet the proportion is brought down to about $6\frac{1}{3}$ to 1, while at 100 feet the proportion is about $6\frac{1}{17}$ to 1.

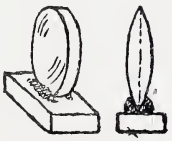
Thus we must be careful to remember that the common saying about the size of the image being proportional to the distance between the pinhole (or lens) and screen is only true when the distance between the object and pinhole is fixed, as in the last experiment, but is approximately true when the distance of the object for the pinhole (or lens) is *considerably* greater than the distance between the pinhole and image screen.

We shall subsequently see that when the telephoto lens is being used for comparatively near objects (portraits, architectural details) the results of our last experiment will have a practical application. It is desirable that these two fundamental experiments be kept in mind.

(3). For our next experiment it will be useful (though not essential) to use an empty cigar box. The lid we can cut up into small pieces about 2 inches long and $\frac{1}{2}$ inch wide. The remainder of the box forms a convenient stand for our lenses. But some pieces of card and one or two books will serve, if desired. We shall also need a convex and a concave lens. The most convenient form is the simple unmounted "spectacle" lens obtainable from any practical optician for about sixpence each. If buying such a pair it will be convenient for our purpose to select a bi-convex (or positive) lens of 6 inches equivalent focal length and a bi-concave (or negative) lens of 3 inches equivalent focus.

It may here be explained that the working optician in spectacles is accustomed to reckon his focal lengths in "*diopters*," powers not inches. The diopter corresponds to the metre length, so that roughly we may reckon a plus one diopter lens as a convex lens of 40 inches. Thus, if we ask for a plus 4 lens we shall get a convex lens of just under 10 inches focus, *i.e.* by dividing 40 by the diopter value we get the inches value and *vice versa*. So that for our 6 inch lens we ought to ask for plus $6\frac{2}{3}$ diopter, but they usually go in steps of ·25, so if we ask for a plus 6·50 lens and a 13 minus lens, we shall get a pair very close to 6 inches and 3 inches.

Fig. 28.



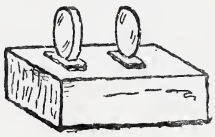


Fig. 29.

Failing simple or spectacle lenses we shall probably be able to manage with the positive large and negative small lenses removed from one of the tubes of a pair of opera glasses. Or we may borrow from a short-sighted friend a pair of his folders and use them in conjunction with our ordinary camera lens. But what we should try to get is a positive lens and a negative lens of which the focal length of the former is about double that of the latter; that is why we pitched upon 6 and 3 inches

above, but 8 and 4 would have done just as well. Assuming we have a 6 inch convex and 3 inch concave spectacle lens, take one of the small strips of wood $2 \times \frac{1}{2}$ inch and on the centre put a good sized drop of melted sealing wax. Just before the wax sets, bring down onto and into it the edge of one of our lenses, being careful to hold the lens vertically. The wax is now moulded between the fingers to make it grip the edge of the glass and we have an arrangement something like that shown in fig. 28. This little homely dodge enables us to try the effect of combining two or more lenses near together or at various distances apart, and when we wish to put two or more such lenses within a few inches of each other, we shall find our cigar box, when set on its side, forms a convenient stand (fig. 29).

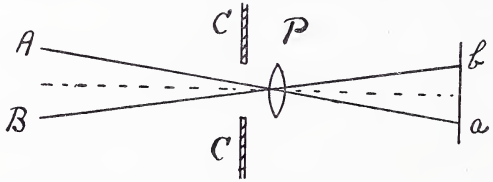


Fig. 30.

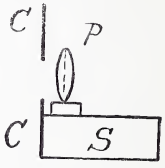


Fig. 31.

4. As before, put the two candle flames A, B, ten inches apart at one end of our long table (Fig. 30). Put the 6 inch focus single lens P, 66 inches from the candles A, B, and set up the white focussing screen $6\frac{3}{5}$ inches from P, the lens. In order to protect the focussing card screen from light not passing through the lens, we set up a large sheet of card C, C, close to the lens P, and having in it a hole just a trifle smaller than the lens itself. This card should very conveniently be held in position by fixing it with drawing pins to the end of the cigar-box stand S (fig. 31). If our lens is exactly 6 inch focal length and our other adjustments carefully made, we ought to get on the screen the images *a*, *b* (of the flames A, B) just one inch apart.

5. Now take our 3 inch negative or concave lens N, and interpose it between P and the image screen and as near to the latter as convenient (fig. 32). We shall find that it makes very little difference in the size, or distance apart of the images *a*, *b*.

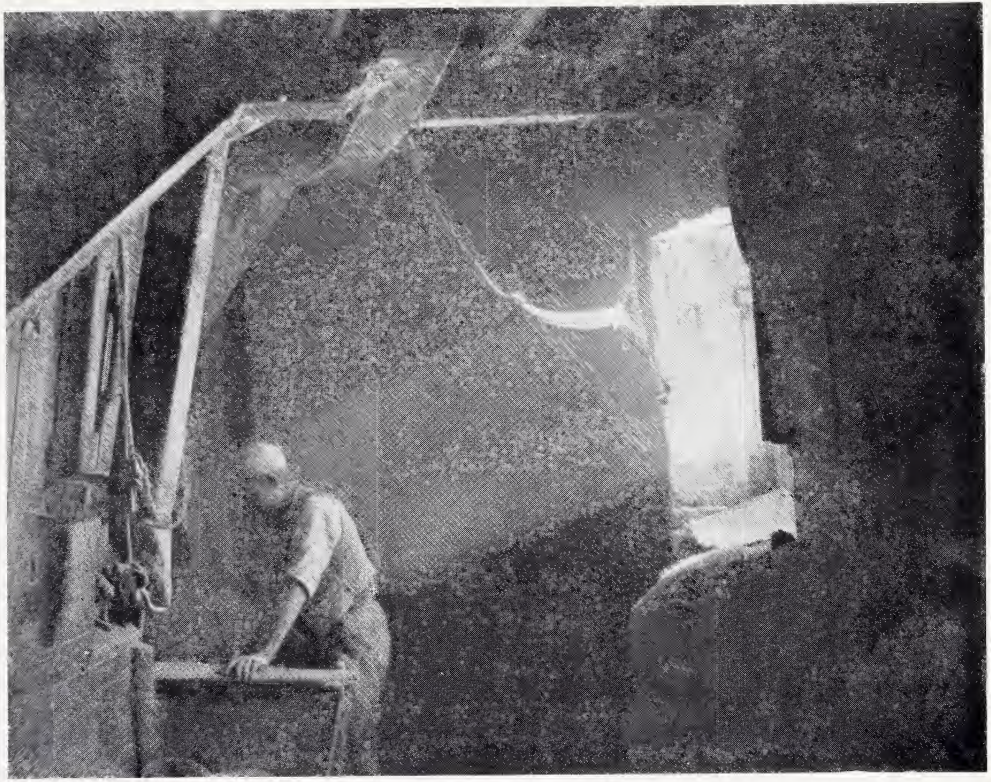


Fig. 6 (p. 4).

A. H. Blake.

The Miller's Man.

6. Then, without moving any other part of our present arrangements, gradually bring the negative lens N a little way towards P, the convex lens(fig.33). We shall observe several very important things: (1) our images *a*, *b*, are no longer in sharp focus, (2) to get them again into sharp focus we must increase the distance between the screen and lenses; (3) the images are further apart. The hasty observer may be inclined to say that the images are further apart simply because we have increased the distance between the focussing srceen and lens or lenses. But by the aid of a tape measure we shall easily ascertain that the increase in the distance apart of *a*, *b*, *i.e.*, the increase of our focussing screen image is proportionally considerably greater than the increase of distance between screen and lens.

Fig. 32.

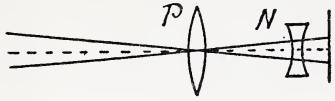
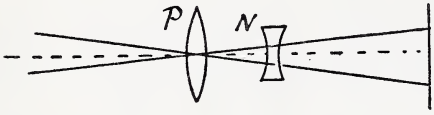


Fig. 33.



Therefore, we conclude that with these two simple lenses we have a means whereby we can get, at will, a large or small image of our object AB, and that the size of the image grows more rapidly than does the distance between the image screen and lens system. In other words, we have a method of getting a large size of image without the use of a proportionally long camera bellows.

Here, then, we have the essence of a telephoto system which calls for more careful and accurate experiment. Before proceeding further it will be well to try and form some sort of mental picture as to how these two lenses (convex and concave) are operating in consort. Previous experience with lenses has taught us that when a *di*vergent pencil of light AB, CD, coming from a distant object falls upon a convex lens L (fig. 34), the rays of light are rendered *con*vergent to some such point as F. But if, instead of letting these converging rays meet at F, we interpose a diverging or concave lens Q (fig. 35), it will, having a diverging effect,

cause the converging rays to be less converging, so that they will not meet at F but at some more distant point such as G. This we can easily verify by using *one* candle flame at the opposite end of the room

Fig. 34.

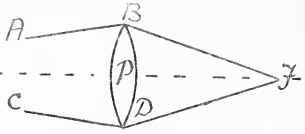


Fig. 35.

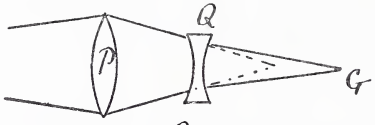
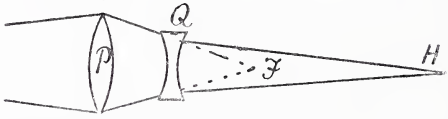


Fig. 36.



We use our 6 inch focus convex lens and get as sharp an image as we can and carefully note the distance between lens and image. Now let us interpose our 3 inch focus concave lens Q, and let it be only a small distance from the focussing card screen, *i.e.*, image as in fig. 35. We shall find that to get a sharp image again we must move our focussing screen back to G.

Next we bring the concave lens Q a *little* nearer to the convex lens, and once again we shall have to draw back our focussing screen to H (fig. 36). From previous experience we shall expect and find that increasing the distance between a lens (or lens system) and the image means an increase of image size.

This point calls for very careful notice. Take a piece of card or paper and rule a straight line down its centre; then mark this off into quarters of an inch for a space of say 2 inches and rule short lines across the first line at each $\frac{1}{4}$ inch mark, thus  Now set up the two ten-inches-apart candle flames at the opposite end of the room and arrange the 6 in. convex and 3 inch concave lens to give this ten inch distance as one inch on the image screen. Place the front edge of the card bearing the concave lens to coincide with the first of the marks on the paper just mentioned. It will then be easy to shift this lens one quarter of

an inch at a time without disturbing the other lens. Having carefully observed the size of the image, then move the concave lens nearer to the convex lens by one of the quarter inch spaces on the card, rearrange the focus and measure the size of the image. Again move the concave lens one quarter inch nearer and again adjust and measure the image. It will thus be realised that the size of the image grows at an increasing rate for each approximation of a quarter inch space.

Without troubling the reader with mathematical formulæ at this stage, it may suffice to say that when the distance between the concave and convex lens is equal to the difference of their focal length, then the screen would have to be at an infinite distance. This then is our limit of nearness of the lenses, Again, a moment's thought will show that we cannot usefully put our concave lens further away than 6 inches, because that is the focal length of our convex lens.

We are, of course, supposing that our object (*e.g.*, two candles) is (are) at a considerable distance. We thus get two limits, *viz.*, 6 and 3 inches, for the separation of the two lenses.

Subjoined is a table showing the practical part of this distance.

A TABLE.

Showing the effect of various positions of a 6 inch convex and a 3 inch concave lens. The first column shows the distance between these two lenses. The second gives the resulting equivalent focal length of the combination. The third shows the consequent magnification of the image.

Separation.	Equivalent Focus.	Magnification.	Back Focus.
3 inches	(*Infinity*)	—	(*Infinity*)
$3\frac{1}{4}$,,	72	12	33
$3\frac{1}{2}$,,	36	6	15
$3\frac{3}{4}$,,	24	4	9
4 ,,	18	3	6
$4\frac{1}{4}$,,	$14\frac{2}{5}$	$2\frac{2}{5}$	$4\frac{1}{5}$
$4\frac{1}{2}$,,	12	2	3
$4\frac{3}{4}$,,	$10\frac{2}{7}$	$1\frac{5}{7}$	$2\frac{1}{7}$
5 ,,	9	$1\frac{1}{2}$	$1\frac{1}{2}$
$5\frac{1}{4}$,,	8	$1\frac{1}{3}$	1
$5\frac{1}{2}$,,	$7\frac{1}{5}$	$1\frac{1}{5}$	$\frac{3}{5}$
$5\frac{3}{4}$,,	$6\frac{6}{11}$	$1\frac{1}{11}$	$\frac{3}{11}$

A glance at this table will show us that such a separation as $3\frac{1}{4}$ inches, resulting in an equivalent focal length of 72 inches is not practical for our experimental porposes, but the reader is advised to observe the effects of at least $3\frac{1}{2}$, 4, $4\frac{1}{2}$ and 5 inch separations with the corresponding magnifications, 6, 3, 2 and $1\frac{1}{2}$. And if he has arranged the 6 inch convex lens to give by itself a one inch image the observations will be greatly simplified. The beginner may here be cautioned against confusing the equivalent focal length with the distance between the image and either of the two component lenses.

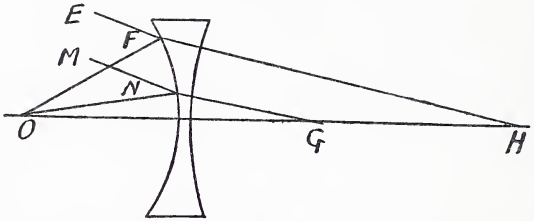


Fig. 37.

But the beginner may very naturally ask why it is that merely altering the distance between the two lenses makes so much difference in the equivalent focal length of the combination. Let us again glance at figs. 35 and 36, and note that the marginal rays after passing through P fall upon Q, not only at a different place (which is unimportant) but that they meet the surface at a different angle, which is of very great importance. In fig.37 we show two rays only. When the two lenses are near together (fig. 36) the marginal ray AB, after refraction through P, falls on Q in such a direction as FF, and is refracted towards H. But when the lenses are further apart, as in fig. 35, the ray AB, passing through P falls on Q in such a direction as MN. The lines OF, ON, are drawn from the centre of curvature of this surface, and so are normals to the curve. Hence the angles EFO and MNO are the angles of incidence, and we need hardly point out that as EFO is greater than MNO the ray EF is more refracted than is the ray MN, so that bringing the lenses nearer together means throwing the

image further back, *i.e.*, from G to H, and at the same time reducing the angle at which the refracted marginal rays meet.

This brings us to another important point, *viz.*, the equivalent focal length of the system.

A glance at the table on p. 15 will show us that for each quarter inch of reduced distance between the two lenses we get a growing increase of equivalent focal length and consequent magnification. For example, reducing the separation from $4\frac{1}{2}$ to 4 inches means increasing the equivalent focus from 12 to 18 inches, and increasing the magnification from 2 times to 3 times. But reducing the separation by another half-inch, *viz.*, from 4 to $3\frac{1}{2}$ gives us an increase of focal length from 18 to 36 inches and an increase of magnification of image from 3 times to 6 times. *But*—and this is of first importance—the distance between the concave lens and image is not increased in this rate.

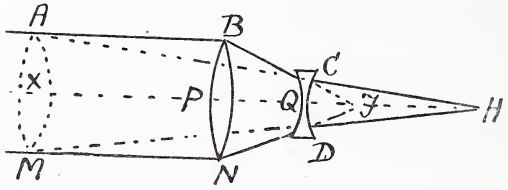
Now it is customary to speak of the distance between the image and the lens next to it as the Back Focal Length, or briefly as the "Back Focus," and it is a quite simple matter to calculate what these Back Focal Lengths are. We have added in the 4th column of the table these Back Focal distances, and we would strongly recommend our readers to verify these distances when making other experiments. But they must expect to find that the actual or measured distances will be a trifle larger than those given in the table. Because the calculations assume the object to be at a considerable distance, whereas in our dining-room experiments we are probably limited to some 20 or 30 feet of working distance.

The question now arises as to what is the meaning of this equivalent focal length, and to or from what it is measured.

Let us suppose now that we are dealing with some luminous object at four or five hundred yards distance so that we may regard the rays of light from it which fall upon our lens as practically parallel. Let AB, MN, fig. 38, be such a parallel beam of light falling on P, the convex (or ordinary) lens of our camera. Under ordinary conditions this parallel beam would be brought to a focus at

F, such that PF is the equivalent focal length of the lens P. But we have interposed a concave or diverging lens Q, which brings the beams AB, MN to a focus not at F but at H. Now let us prolong the lines HC, HD, until they meet the lines AB, MN at A and M. Then our two lenses P and Q are acting just like a single lens placed at AM and having an equivalent focal length of XH. Then we may call this imaginary lens X, the equivalent lens of the system P and Q.

Fig. 38.



It will now be easy to see that we can imagine two workers, Smith and Jones, photographing the same object from the same standpoint. Smith is using a lens of 18 inches equivalent focal length and, of course, a camera with a bellows rather more than this length. Jones uses a telephoto combination of 6 inch convex and 3 inch concave lens, put 4 inches apart and with a back focus of 6 inches, and gets the same size of picture although his camera extension is only about 10 inches. (Note that by adding the "separation" and back focus we get the distance between the front lens and the plate.) Thus the telephoto-ist usually has the advantage of a much shorter camera than the user of an ordinary long-focus lens.

View Angle.—One of the points which often puzzles beginners with a telephoto lens, is the question of view angle. But a simple experiment should make this quite clear.

Set up three lighted candles in a row and a few inches apart, arranging them so that they are exactly at equal distances from each other. Now arrange a positive and a negative lens so as to give the three images, A, B, C, of the candle flames in a horizontal line on the card focussing screen. On the

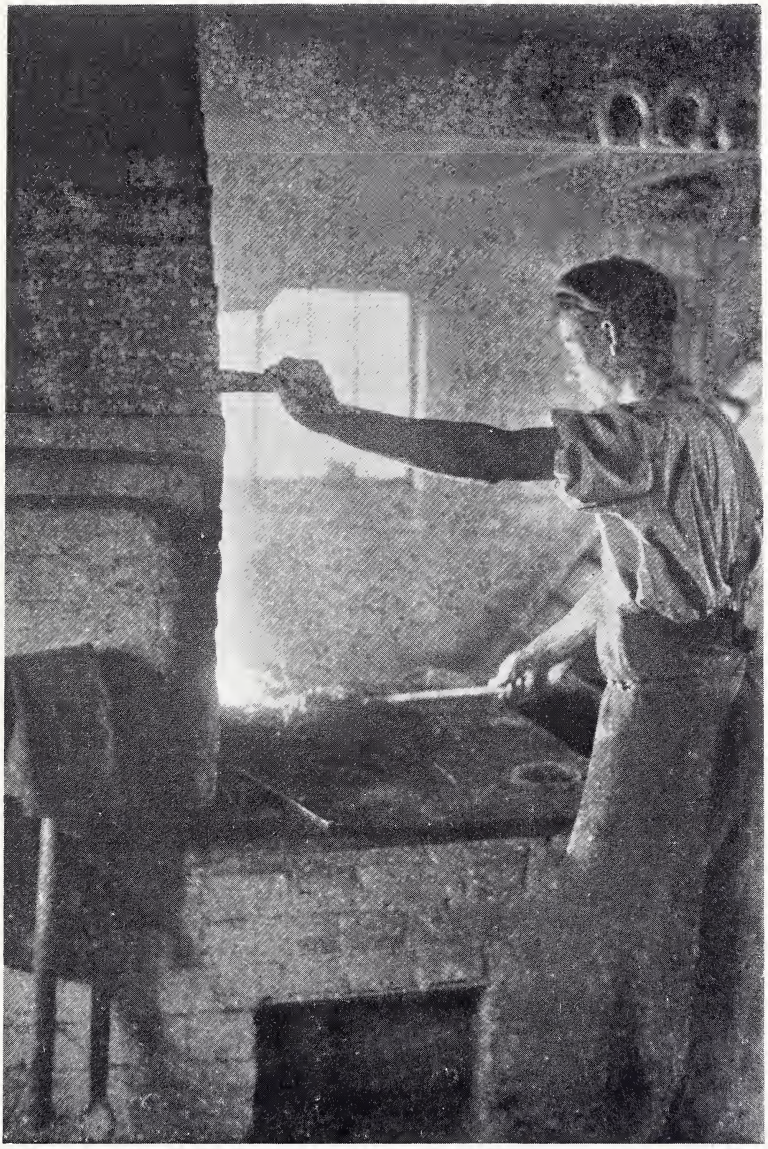


Fig. 7 (p. 5). A. H. Blake.

The Forge.

Fig 8 (p. 5). A. H. Blake.

God's Acre.

card draw a circle with the middle image at centre and the other two on the circumference. Now we can imagine that the two outside images B,C, fig. 39, mark the boundary of our picture, and that all parts outside this circle, viz., BE, CD, are dark because they are cut off by the lens tube. Now we bring the negative lens a little nearer the positive lens. This necessitates retiring the focussing screen (fig. 40). Bringing the lenses together has shortened the obscuring lens mount and so widened the picture angle. Again, it has elongated the focus, or pushed back the focussing screen DE, so that the two outside candle flame images have moved beyond the boundary of the dark circles so that our imaginary plate DE is now quite covered by the picture angle and has now no dark corners. Note carefully that we are not really increasing our picture angle very materially, but what we are doing is enlarging the picture and so spreading it over a larger space on the focussing screen.

Fig. 39.

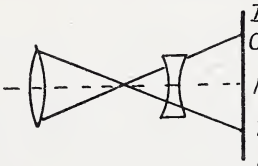
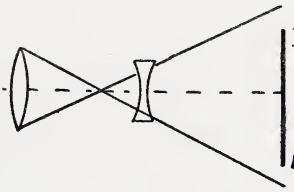


Fig. 40.



Consequently we must bear this in mind when calculating exposure. It would be a natural but serious mistake to suppose that because we were using the same stop in both the cases shewn in figs. 39 and 40, that the same exposure should be given. What should guide us in such a case would be the relative areas covered by the same picture.

Telephoto Calculations by Simple Arithmetic.

By A. CANTAB.

"LEAVE out as much theory as you can and make the chapter as simple and practical as possible." So ran my instructions. Therefore, gentle reader, should'st thou find my mathematics distinctly 'scrappy,' I pray thee have me excused.

And now for the arithmetic of the telephoto lens, which for all practical purposes is very much like that of any ordinary photographic lens, "provided always," as the lawyers say, that we do not forget that we are dealing with a convex *and* a concave element separated by a space which cannot be neglected. Let it be understood that what hereafter follows is only to be taken as approximations. Nevertheless, they will be found to be near enough for all practical purposes.

For example, we may measure by experiment our negative element and estimate its equivalent focal length to be 4 inches, whereas in truth it may be as much as a $\frac{1}{4}$ inch more, or less, than this quantity, *i.e.*, $3\frac{3}{4}$ or $4\frac{1}{4}$. Yet our error of $\frac{1}{4}$ inch will not in daily practice have any very serious effect, because the end of our calculations is either a guide to exposure or to the scale of magnification. Now the latter we can verify within a very small error by measurements on the focussing screen. And as regards exposure it matters very little whether we give one second more or one second less when ten seconds' exposure yields a quite satisfactory negative with normal development. Nevertheless, let us be as exact in our measurements and calculations as we can with reasonable care.

In this chapter, we shall follow the usual *photographic* convention and refer to a convex lens or system of lenses giving a real and inverted image as a *positive* lens. We have in mind such lenses or

systems as the familiar single achromatic landscape, the rapid rectilinear, or symmetrical, the anastigmat, ordinary portrait objectives, etc.

Accordingly, we shall call a concave lens or system of lenses, giving an erect, diminished and virtual image, a *negative* lens. The eyepiece at the smaller end of an ordinary opera glass is a familiar instance of such a lens.

We shall now assume that the reader is in possession of an ordinary photographic objective, say a Rapid Rectilinear, and that he has been told it has an equivalent focal length of 8 inches. Also that he has a concave lens which has a focal length of about 4 inches.

Our first business will be to find out where the posterior node or node of emergence, is so that we may know where the equivalent focal length is to be *measured from.*

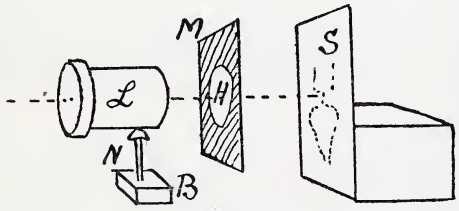


Fig. 41.

Take any small bit of wood about 2×3×1 inches, and about the middle of the flat side drive in a good long (3 inch) brass-headed nail. Let the nail penetrate the wood a good half-inch so that it has a firm hold. Select a window from which some well-defined objects (50 or 100 yards away) may be seen. Such for example as a telegraph pole, chimney, tree, etc. On a firm table placed opposite the open window put the block B in which is the nail N. Take a second block of wood and fix to it a piece of stiff white card S to act as focussing or image screen. Take another piece of card or stiff brown paper M about the same size as S, and in it cut a hole a trifle smaller than the smaller end of the lens tube L.

Close the window curtains or shutter so that only a few inches is uncovered just opposite the table. Stand at the side of the table with the window at your left side. In the left hand take the lens tube

between the thumb and first finger. Rest the tube on the nail head N, and focus the inverted image as sharply as possible on S. If any difficulty is experienced then get a helper to hold M the paper shield an inch or so from the lens, with the opening H opposite the lens, of course. This done then while the lens tube is resting on the nail head give the tube a twist to right and then to left, but keeping the tube horizontal all the time, and observe if the position of the image on S moves to one side when the lens is rotated sideways. If it does then shift the nail head along the lens tube until the image is stationary when the lens tube is rotated. Then mark the position of the nail head by a dot of ink or tiny stratch on the lens tube. Now slip a small elastic band over the lens tube at the ink mark. Imagine this elastic band to shrink and shrink until it just embraced the axial line of the lens. We should then have located the posterior node of the lens.

The anterior node need not concern us at present beyond remembering that it is also situated on the axial line and situated towards the hood end of the lens.

Having got a sharp image of a distinct object we we can now easily measure the distance between the image screen S and the nodal plane or elastic band and so get the equivalent focal length of the lens.

For strict accuracy our object should be at infinity. But if it be situated at a distance from the lens 1000 times the focal length of the lens, the error will be only about $\frac{1}{1000}$ part of the focal length. Suppose our lens to have a focal length of 8 inches. Now 1000 times 8 inches is about 222 yards, so that with an object at 200 yards our error would be smaller than we could easily measure, and if the object be 100 yards the error would still be quite negligible (*i.e.*, about $\frac{1}{125}$ inch).

In this connection it may be useful to mention that we can limit our error by putting the object not less than a certain distance. For instance, suppose we wish that our error shall not exceed $\frac{1}{10}$ inch, and the focal length of the lens is 7 inches.

Then our object must not be nearer to the lens than $10 \times 7 \times 7 + 7$ $(10f^2 + f)$ or 497 inches in this distance—say 42 ft. Or if the error is not to exceed $\frac{1}{50}$ inch with a 6 inch lens, then the distance of the object must not be less than $50 \times 6 \times 6 + 6$ $(50f^2 + f,)$ or 1806 inches; say 150 ft. or 50 yards.

We may now assume that we have ascertained the position of the nodal plane and measured the equivalent focal length of the ordinary photographic (so called positive) objective, within a reasonable and practical degree of accuracy.

We must now repeat operations with telephoto or "negative" attachment, and as the operations are not quite so easy it will be helpful if we commence by measuring a simple concave lens of such form as the ordinary "Oxford eyeglass" or unmounted spectacle lens, which may be obtained from any optician for about sixpence. We shall give three methods of ascertaining the equivalent focal length of such a lens. The first is a somewhat rough and ready direct measurement; the other two have special interest for us, as they are parts of our subsequent calculations of a telephoto system.

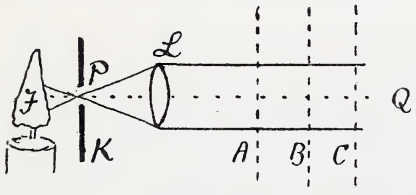


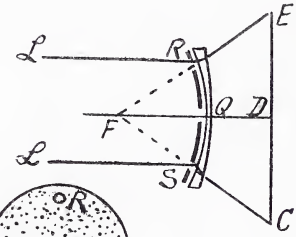
Fig. 42.

Our first requirement is a beam of parallel light, which we can get by fixing a piece of card K (fig. 42) about an inch or so from a candle flame F and then with a large pin or needle making a clean hole P opposite the brightest part of the flame. We now take our ordinary photographic objective L (or any other convex lens) and arrange it with the axis PQ horizontal and in a line with P. The distance between P and L for best effect must be found by trial, but it will be approximately that of the equivalent focal length already ascertained in the manner above described. The effect we want to get is a parallel beam of light on the side of the lens opposite to the candle flame. This we can test by holding a sheet of white card at various positions A, B and C. If the circle of light

on this card is the same size at A, B, and at C, then we may assume the emergent rays are parallel.

We then take our concave eyeglass and cut out a circular piece of thin opaque paper (fig. 45), the same size as the face of the lens. With a soft pencil, rule a diameter of this circle and in this diameter pierce three pinholes R, O, S, such that O is at the centre and R and S at equal distances from O and as near to the circumference as is convenient.

Fig. 43



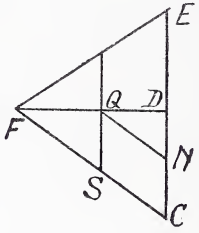
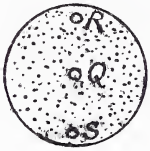


Fig. 44.

Fig. 45.



Now support the lens Q on a lump of sealing wax and bring its axial line into line with LQ (Fig. 42). At a convenient distance—some two or three times the presumed focal length of Q—place a white card screen, when on it will be seen three spots of light E, D, C. A glance at fig. 43 will explain how the parallel pencils LR, LS are refracted to E and C, while the axial pencil continues its straight course to D. We now measure the distancesDE and DC, *i.e.*, from the centre of each spot. These, of course, will be equal, if our adjustments have been made with sufficient care. We also measure DQ and also QR or QS. It will thus appear that a parallel beam of light falling on a concave lens is not brought *to* a focus but is made to diverge *as though it were travelling from a focal point.* Thus LR, LS, after refraction through the lens, behave as though they had started from F. Thus F is a *virtual focus*, for the rays RE, SC only appear to but do not actually pass through F. Now it is this distance FQ that we wish to measure.

Fig 9 (p. 61). Fig. 10 (p. 62). F. C. L.

Portrait Studies with Ordinary and Telephoto Combination.
Sitter and Camera were in the same position for both experiments.

Fig. 11 (p. 35). Charles E Shea

Taken from the Norotan, near Cortina. To the left of the hut is the Croda da Lago, west face.

Fig. 12 (p. 35). Charles E. Shea.

Croda da Lago, from same position as fig. 11. Distance 3-4 miles.

Turn now to fig. 44. QN has been drawn through Q parallel to FC. Then from similar triangles FSQ. QDN, we have ND : DQ :: QS : QF. We must therefore measure QD, DC and QS, then subtracting NC, *i.e.*, QS, from DC, we get DN. Then our rule of three will give us FQ.

Example : Suppose that QR or QS is $\frac{1}{2}$ inch. QD is 24 inches and DC is 2 inches, DN is therefore DC less CN or QS. Thus DN $= 2 - \frac{1}{2} = 1\frac{1}{2}$ inches.

Then DN : DQ :: SQ : QF.

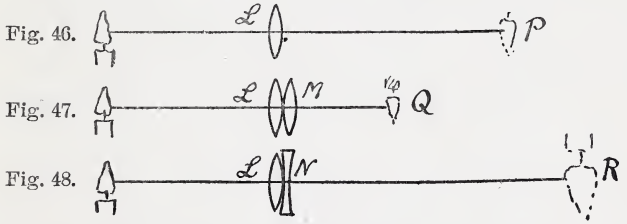
Or $1\frac{1}{2} : 24 :: \frac{1}{2}$ to required distance.

This gives us 8 inches as an answer.

Our next method may best be based upon one or two very simple experiments.

Take any single convex lens, L, and arrange matters so that the inverted image of a candle flame, F, is in sharp focus on a piece of white card at P. Measure LF and LP (fig. 46).

Now take another convex lens M which may or may not be of the same focal length as L, and put the two into contact. Retain the same distance between the candle flame F and the lenses as before. We shall now have a smaller image of the flame, and it will be found at Q (fig. 47), *i.e.*, nearer to the lens L, than in our first experiment.



Once again take the lens L and put into contact with it a concave lens N. Our candle-flame image will now be found at R (fig. 48), where R was further away from L than P was in our first experiment.

We sum this up by saying that the addition of a convex lens shortens, and the addition of a concave lens lengthens, the focus of our first convex lens. The question is, How much does the extra lens affect the focal length of the first lens? The answer is, that it depends on the focal lengths of the two lenses and their distance apart.

If we assume that the lenses are in contact this simplifies calculations, and if we assume that the thickness of the lenses is negligibly small in comparison with the other distances this again simplifies matters.

For example: Suppose we have in close contact two thin convex lenses of 7 and 5 inch focal lengths respectively. To find the focal length of the combination we multiply the two focal lengths (7 and 5) for our numerator, *viz.*, 35, and add the focal lengths (7 and 5) for the denominator (12). In this instance the focal length of the combination would be $\frac{35}{12}$ or very nearly 3 inches.

Similarly a 12 inch and 8 inch pair of convex lens in contact would give us a combination of $\frac{12\times8}{12+8} = \frac{96}{20} = 4\frac{4}{5}$ inches.

If, however, we have a combination of a convex and a concave lens we must make one of them have a minus sign throughout our operations.

Mathematicians are universally agreed to call the focal length of a concave lens positive, and that of a convex lens negative. But apparently photographers go by the rule of contrary, and call concave lenses negative and convex lenses positive. Under protest, we are in this chapter following the photographer's practice. Thus, suppose we put in contact a 7 inch convex (positive) lens and a 5 inch concave lens and follow our formula we get for our numerator $(+7) \times (-5)$ or -35, and for our denomenator $+7-5$ or $+2$. Thus $\frac{-35}{+2} = -17\frac{1}{2}$. The equivalent focal length is $17\frac{1}{2}$ inches, and the minus sign tells us that it has a virtual focus, like our concave lens, of 5 inches. Hence with such a combination of lens in contact we could not get an image on our focussing screen.

If, however, we combine a concave lens of 7 inch focus with a convex lens of 5 inch focus, our formula gives us -35 for numerator as before, but our denominator is $-7+5$ or -2. Hence the combined focus is $\frac{-35}{-2}$ or $+17\frac{1}{2}$. Such a combination gives us a real image, and hence we get the hint

for estimating the focal length of one lens when we know the focal length of the other. Observe that the convex lens of such a pair must have a shorter focus than that of the concave lens to be measured.

Suppose now we have a thin concave lens whose focal length we suspect to be somewhere between 6 and 7 inches, we must put it in contact with a convex lens of focal length less than 6 inches, and it is convenient to have it about half this value. Say we use a lens of 3 inch focal length.

We now get an image of a distant object with the two lenses in close contact, and measure the distance of this image to the contact surface of the two lenses. Let this be $5\frac{1}{4}$ inches by way of example. Call this F, and call the focal length of the single positive lens f, *i.e.*, 3 inches. Then the focal length of the negative on concave lens will be easily found from the formulæ $\frac{F+f_1}{F-f_1}$

Substituting the values of the above example we get

$$\frac{5\frac{1}{4}\times 3}{5\frac{1}{4}-3} = \frac{\frac{21}{4}\times 3}{\frac{21}{4}-3} = \frac{21\times 3}{21-12} = \frac{21\times 3}{9} = \frac{21}{3} = 7$$

Thus the focal length of the negative lens is 7 inches.

Now let us see what happens when we have an appreciable distance between two thin lenses.

First, take the case of two convex lenses. Let us turn back to the experiment indicated in fig. 47. We shall find that by putting the two lens L, N a short distance apart, say an inch, we have caused the candle image at Q to be further away from L, and the more we increase the "separation" of the lenses (as their distance apart is called) the further away does Q retire. And when the separation is equal to the two focal lengths added together the combined focal length is at infinity.

To take a precise example. We have already seen that a 7 inch convex lens and a 5 inch convex lens in *contact* give a resulting focal length of $\frac{35}{12}$ or $2\frac{11}{12}$ inches.

Suppose now we put these lenses 2 inches apart. What happens? We can get the focal length by subtracting this 2 inches from our denominator. Thus, instead of $\frac{35}{12}$, the focal length is now $\frac{35}{10}$, or $3\frac{1}{2}$ inches. Putting the two lenses one more inch apart, we get a combined focus of $\frac{35}{9}$, or very nearly 4 inches. Again separating them one more inch, the combined focal length is now $\frac{35}{8}$ or $4\frac{3}{8}$, and so on.

Next consider the case of a negative and a positive lens separated in a similar manner. Take the case of a 7 inch convex (positive) and a 5 inch concave (negative) lens. In contact we get a negative focus of $\frac{7\times(-)\,5}{7+(-\,5)}$ or $\frac{-35}{+\,2} = -\,17\frac{1}{2}$ inches. Putting them 2 inches apart and subtracting this "separation" from the denominator as before, we get $\frac{-35}{7-5-2}$ or $\frac{-35}{0}$ = infinity.

It is of importance to remember that when we have a convex lens and concave lens separated by a distance equal to the difference of their focal lengths, we get an infinity focus or parallel rays.

If we go on separating our + 7 and - 5 inch lenses one inch more we have

$$\frac{-\,35}{7-5-3} = \frac{-\,35}{-\,1} = +\,35;$$ or an equivalent focus of 35 inches. A further separation of another inch gives us a focal length of $\frac{-\,35}{7-5-4} = 17\frac{1}{2}$

Yet another inch separation and we have

$$\frac{-\,35}{7-5-5} = 11\frac{2}{3}$$ and so on.

To put the matter in tabular form for a convex lens of + 7 inches focus and a concave lens of — 5 inches focus.

Separation	2	3	4	5	6	7
Equivalent Focus	Infinity	35	$17\frac{1}{2}$	$11\frac{2}{3}$	$8\frac{3}{4}$	7

Here then we have the basis of the usual telephoto lens, *viz.*, a convex or positive lens combined with a concave lens of shorter focal length than that of the convex lens, *separated by a suitable interval.*

A glance at the above table shows us that the separation must be more than 2 (*i.e.*, 7—5) and not as great as the focal length of the convex lens, *viz.*, 7.

In *theory* the focal length of the negative lens may be anything we please provided it is less than that of the positive lens, but in practice it is not generally convenient to have it less than $\frac{1}{4}$ or more than $\frac{3}{4}$ that of the convex lens (except for special purposes) while daily practice shows that the most convenient proportion is just about half that of the convex lens.

We are now in a position to tabulate matters for any pair of lenses we please. Assuming the reader to possess an ordinary photo-objective of, let us say, 8 inches equivalent focus, and he contemplates buying a negative telephoto attachment having a focal length of 4 inches, but wishes to see how matters will work out before he gives the order. He will want to know (1) what equivalent focal lengths he will get with various separations, (2) what magnifications these will give him, and (3) what length of camera bellows will be required under the various circumstances.

The range of separation will be from 4 (*i.e.*, 8—4) to 8 inches.

To get the equivalent foci we may make a short cut thus: Supposing we are tabulating for each $\frac{1}{4}$-inch, *e.g.*, $4\frac{1}{4}$, $4\frac{1}{2}$, $4\frac{3}{4}$, etc., multiply the two foci together ($8\times4=32$); bring this to quarter inches (128), and divide by as many quarter inches as the separation is beyond 4. Thus at $4\frac{3}{4}$ inches' separation we have to divide 128 by 3, and get $42\frac{2}{3}$. A 6 inch separation is 2 inches beyond the minimum limit of 4, and 2 inches is equal to 8 quarters, so we divide 128 by 8 and get 16, and so on.

There yet remains the third method of finding the focal length of a negative lens which we may now conveniently consider, because we can at the same time calculate the "back focus" of the telephoto system, *i.e.*, the distance between the concave lens and the focussing screen.

In fig. 49. Suppose we have light coming from a luminous point so far distant that we may consider the rays falling on a convex lens L to be practically parallel. Thus AB, CD may be regarded as

parallel to the axis of the lens LQ. Then AB and CD would be brought to a focus at P, the principal focus of the lens L. If now we interpose a concave lens N these rays will not be brought to a focus at P, but at Q, a more distant point. Thus we could suppose the light to start from Q towards the concave lens along N and be refracted at N to B so that it would then be travelling in the direction of the straight line PB as though it started from the virtual focus P. Hence P and Q are conjugate foci of the lens N. We shall now assume that the reader is familiar with the fundamental formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1}$ where v=NP. u=NQ and f is the focal length of the lens.

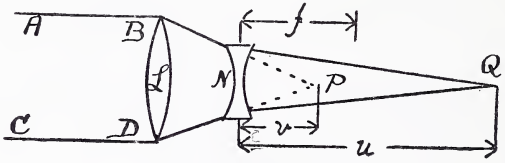


Fig. 49.

The same formula may for our present purpose be rearranged thus : $f_1 = \frac{u \times v}{u - v}$ We first find the position of P, *i.e.*, the conjugate of a distant point refracted through the lens L. We now interpose the lens N at a carefully measured distance from P and observe the distance of Q from N.

By way of example suppose NP or v to be 5 inches and NQ or u to be 25 inches. Substituting in the above formula we get $\frac{25 \times 5}{25 - 5} = \frac{125}{20} = 6\frac{1}{4}$.

We can, however, again re-arrange our fundamental formula in yet another way, *viz.*, $\frac{vf_1}{f_1 - v} = u$ Thus knowing NP and the focal length of the concave lens N we can get NQ or u, *i.e.*, the back focus.

We can easily get NP or v by subtracting LN, the separation from LP the focal length of L.

Fig. 13 (p. 35). Charles E. Shea.

View from a bedroom window in Hotel Post Taufers and Schloss Taufers (Tyrol). Ordinary Lens.

Fig. 14 (p. 35). Charles E. Shea.

Schloss Taufers, from same bedroom window. Telephoto combination, moderate power.

Fig. 15 (p. 35). Charles E. Shea.

Schloss Taufers, from the further side of the village ($\frac{1}{2}$ mile). The background of mountains is lost by too great propinquity to the Castle, which is 400 feet above the valley level. Ordinary Lens.

Fig. 16 (p. 35). Charles E. Shea.

Schloss Taufers from near Winklebad; one mile further away than above, *i.e.*, $1\frac{1}{2}$ miles from Castle. Distant peaks, 10 miles. Telephoto Combination. Moderate Power.

One or two examples will make matters quite clear. The negative lens in the accompanying table has a focal length of 4 inch, *i.e.*, $f_1 = 4$ and LP is 8 inches. Suppose the separation LN to be 5 inches. Then NP $= 8 - 5 = 3$ inches $= v$. Substituting we get $u = \frac{vf_1}{f_1 - u} = \frac{3 \times 4}{4 - 3} = 12$.

Again, suppose the separation to be $4\frac{1}{2}$ inches. We get $v = 8 - 4\frac{1}{2} = 3\frac{1}{2}$. Substituting we have $u = \frac{3\frac{1}{2} \times 4}{4 - 3\frac{1}{2}} = 28$.

Similarly the other values may be filled up in the fourth column.

A table showing the relative effects and distances of an 8-inch convex and 4-inch concave lens:—

Separation.	Equivalent Focus.	Magnification.	Back Focus.
4	∞	—	∞
$4\frac{1}{4}$	128	16	60
$4\frac{1}{2}$	64	8	28
$4\frac{3}{4}$	$42\frac{2}{3}$	$5\frac{1}{3}$	$17\frac{1}{3}$
5	32	4	12
$5\frac{1}{2}$	$21\frac{1}{3}$	$2\frac{2}{3}$	$6\frac{2}{3}$
6	16	2	4
$6\frac{1}{2}$	$12\frac{4}{5}$	$1\frac{3}{5}$	$2\frac{2}{5}$
7	$10\frac{2}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$
$7\frac{1}{2}$	$9\frac{1}{7}$	$1\frac{1}{7}$	$\frac{4}{7}$
8	8	1	0

Magnification.—The reader is doubtless aware that when dealing with distant objects the relative sizes of the images we get are practically proportional to the focal length of the objective in use. The relative size or magnification of a telephoto combination formed image as compared with the size of the image of the same object formed by the positive lens alone (*i.e.*, without the negative attachment) is then a matter of comparing the two focal lengths.

If, therefore, in the adjoining table we divide the equivalent focal length of the system given in the second column by 8 inches, *i.e.*, the focal length of the positive lens alone, we shall get the proportion or magnification or relative sizes of the images.

Now it is interesting to note that this back focus, which we may conveniently denote by B, has a certain relation to the magnification which we may denote by M.

This relation is expressed thus $B=(M-1)\ f_1$ or $M=\frac{B}{f_1}+1$.

That is to say, if we multiply the "magnification-number-less-one" by the focus of the negative lens we get B.

Thus in the table a magnification of 4 requires a back focus of 12 inches or B the back focus, *viz.*, 12= "Magnification-less-one," *i.e.*, 4−1 (or 3) multiplied by f_1 the focus to the concave lens. Similarly with 16 magnification we have 60=(16−1) 4.

Or again, if we know the back focus and divide this by the focus of the back lens, and then add one we get the magnification.

Thus—Dividing back focus 28 by 4, *i.e.*, $\frac{28}{4}=7$ and adding 1 we get 8, the corresponding magnification.

Or again—Dividing the back focus, 12 by $4=\frac{12}{4}=3$. To this add 1 and get 4, the corresponding magnification.

Estimating Exposure.—(It is necessary that the equivalent focal length of the positive and also the negative element be known. By way of example assume that the former is 7 inches and the latter 3 inches.)

1. Measure the distance from the negative lens to the focussing screen (say 12 inches). Divide this (12) by one plus the focal length (3) of the negative element. Thus 12 divided by 4 gives us a magnification of 3 times.

2. By multiplying the focal length of the positive lens (7) by the magnification (3) we obtain the equivalent focal length of the system (21 in.).

3. If we multiply the marked value of the stops of the positive lens by the magnification, we obtain their aperture value in the system. Thus *f*/8, with three magnifications, is really *f*/24.

4. Exposures vary directly as the square of the linear magnification. Assuming that with the positive lens alone and stop *f*/8 an exposure of one second would be correct, then with the telephoto attachment adjusted to give a linear magnification of 3 times and the same stop, we should require 9 seconds' exposure. Or if the magnification be

4 times, the corresponding exposure with the stop marked *f*/8 would now be 16 seconds, or with 5 magnifications 25 seconds, and so on.

5. When comparing the exposure with one stop using the positive lens alone with a telephoto combination and another stop, due allowance must be made for the change of stop. For example, suppose 3 seconds' exposure to be given with the positive lens using *f*/22. Then a negative lens is added giving a magnification of 4 times, which increases the exposure 16 times, *i.e.*, to $16 \times 3 = 48$ seconds with the same stop as before. But if this be now changed to that marked *f*/16 we must give 24 seconds, or if the stop be changed to *f*/8 then we must only give 6 seconds.

Magnification depends upon the distance between the negative and positive portions of the combination, for the same pair of lenses. Or, to put the matter in tabular form,

A six inch convex lens

Combined with a 3 inch concave lens.		Combined with a 4 inch concave lens.	
Separation.	Magnification.	Separation.	Magnification.
4 inches.....	3	4 inches.....	2
$4\frac{1}{2}$	2	$4\frac{1}{2}$	$1\frac{3}{5}$
5	$1\frac{1}{2}$	5	$1\frac{1}{3}$

It must always be remembered that *magnification* is dependent upon the focal length of the *negative* lens, irrespective of that of the positive lens, *e.g.*, with a 6 in. positive and a 3 in. negative and an extension of 12 inches we have a magnification of 5 diameters and a resulting equivalent focal length of 30 inches. With a 9 in. positive and the same 3 in. negative with 12 inches camera extension we should still get a magnification of 5 diameters, but the resulting equivalent focal length is 45 inches, exactly in proportion to the focal lengths of the positive lenses. This serves to illustrate the terms high and moderate-power attachment; the 3 inch is a moderate-power attachment for the 6 in. lens, but a fairly high power for the 9 in. lens. Low-power attachments are from $\frac{2}{3}$ to equal the focal length of the positive lens. They are useful for pictorial landscape work and por-

traiture and will probably play an important part in time to come.

How to Graduate the Baseboard of a Camera for Telephoto Work.—It is often a great convenience to set the camera back at such a point that it will give a desired degree of magnification, and this is quite a simple matter when once the focal length of the negative lens is known. We shall here assume that this has been ascertained. By way of example let us assume that it is $2\frac{1}{2}$ inches. We shall also assume that when the telephoto system is in the camera the *relative position* of the negative lens N, and camera front KK, is fixed, so that any alteration between the negative N and positive P parts of the system is made by moving the positive lens P backwards or forwards.

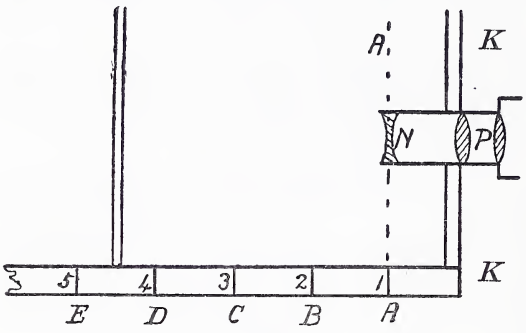


Fig. 50.

Remove the focussing screen and close up the camera until a flat ruler laid across the open camera back is level with the centre of the negative lens N. This ruler will occupy such a position as the dotted line AA. We now mark the baseboard at A. This is our zero or starting point of the scale. Then lay out equal distances AB, BC, CD, etc., each equal to the focal length of the negative lens N, in our case $2\frac{1}{2}$ inches. Then mark A as 1, B as 2, C as 3, and so on. If now we wish to have our scale of magnification $4\frac{1}{2}$ times, we should set the grouud glass GG midway between D and E, and then get the image sharp by altering the position between the two lenses N and P.

A glance at the formula $B = (M-1) f_1$ tells us that the back focus is equal to the focal length of the negative lens multiplied by the "magnification-less-one," and explains the above procedure.

Telephotography and Mountaineering.

THE ordinary landscape photographer is, for the most part, concerned with subjects whereof the more important parts are within a mile of his camera, and indeed his foreground is often not more than a score yards away from him. But the mountaineering photographer is frequently interested in subjects whereof the nearest portion may be a mile or more from his camera, and the distant portions ten or even twenty miles away. Much as he may wish to approach his subject it may not be practicable by reason of some deep and wide intervening valley. Even should this not be the case and he is able to plant his tripod at the very foot of the mountain to be photographed, it is highly probable that such a view point will only yield a picture characterised by distorted perspective partly due to the low level view point, partly to the great difference in the relative distances of the different parts of the picture. Indeed, it may be said that a view of a mountain taken from its base is rarely satisfactory in any respect.

Then again, from any of the same elevated positions with the telephoto lens we often can take a series of large scale pictures of the surrounding scenery. Each of these with the ordinary lens would involve a separate journey in order that we might approach the various subjects in turn. Thus to some extent does this optical instrument enable the worker to annihilate distance.

Once again, the view of a peak from another of approximately the same height is so vastly different from that obtained from a lower and nearer view point that it is quite probable that the former might reveal or suggest some new or untried method of ascent.

Pictorial Composition.—The telephoto equipment frequently enables the mountain landscapist to deal with subjects so distant that they would be out of the question with the ordinary photographic outfit. Not only does the former instrument permit large scale pictures of distant objects, but also permits a very considerable choice in the degree of magnification. The former qualification enables the artist to select his view point with almost unlimited freedom; the latter enables him to adjust his angle of view to suit the size of the picture. The position of the view point is of the utmost importance in mountain scenery. From a low position a certain peak may stand out bold and clear in sharp silhouette against the open sky. From a higher position it may come as one of a series of peaks apparently of about the same altitude. From a still higher point it may be more truthfully shown as a dwarf in comparison with some higher mountains in the distant background. Again, should the camera be too near a small hill it may be rendered out of all truth of proportion and come as a giant. On the other hand, too great distance may dwarf it into insignificance.

Focusing (See Notes on page 38).

Exposure.—It is difficult to overstate the great desirability of giving a correct exposure. This done, development is comparatively a simple matter. But under-exposure or over-exposure will in all probability, even with the utmost care in development, be liable to convey a wrong impression of light and shade contrast. Under-exposure is the more probable error of the two. First, because the beginner is apt to under-estimate the rapid falling-off in the value of the light as the magnification rate increases. For instance, a four times magnification requires very nearly double that required by a three-times magnification. Again, the air of mountainous districts and high altitudes is usually so much clearer and freer from floating dust particles than is the air near towns that it diffuses or scatters less light. Hence the light and shade contrasts of distant objects is more pronounced than is usual. This again calls for generous, but not excessive, exposure.

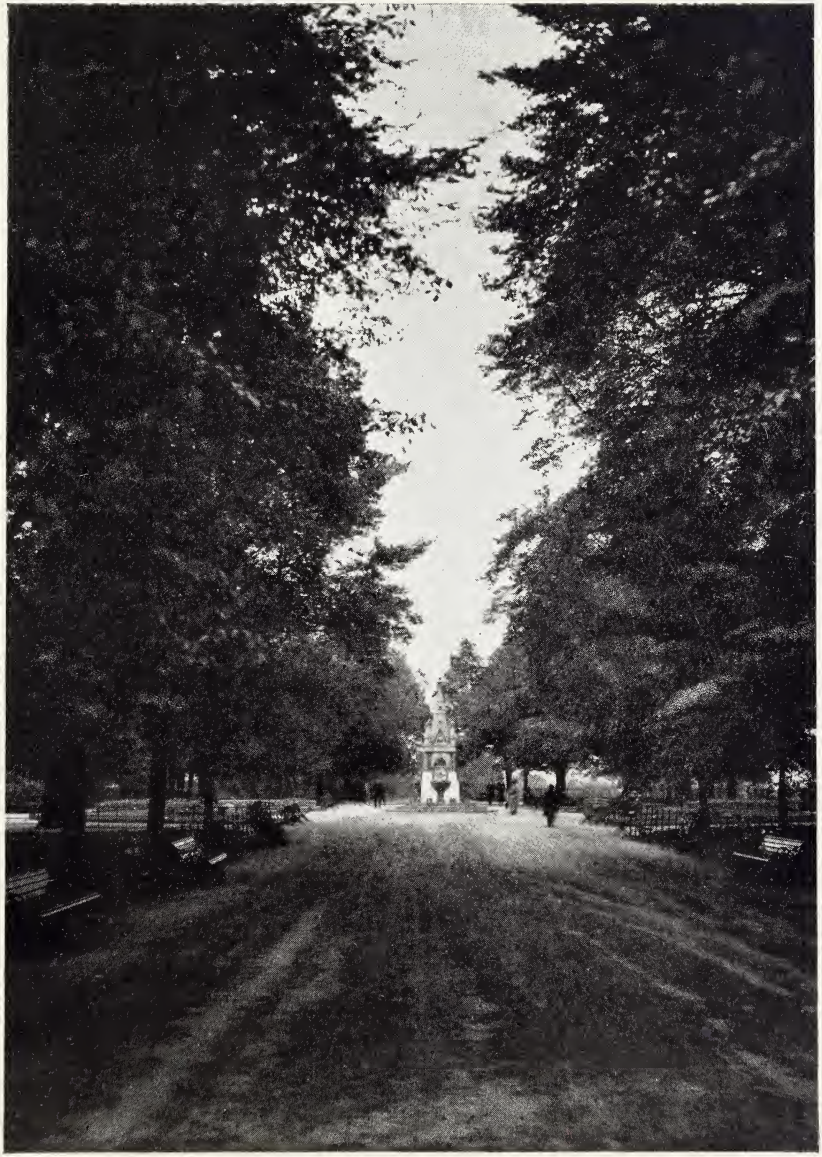


Fig. 17 (p. 62). F. C. L.

Mid-distance Landscape with Ordinary Lens.

Fig. 18 (p. 62). F. C. L.

From same standpoint as fig. 17, with low-power telephoto combination.

(For methods of calculating exposure see page 32).

Hints.—Pictures of distant peaks, etc., are best taken in the earlier hours of the day, *i.e.*, before the sun has had time to heat the dark rocks and so give rise to those quivering air currents which are as serious a danger to the photographer as is the quivering or vibration of the camera itself.

The strongly-lit snow-clad parts may tempt the unwary to base exposure on this part of the picture, but experience shows that in mountain scenery, as elsewhere, the safest and soundest policy is to follow the well-established rule of exposing for the nearest dark part of any importance.

Applications.—Imagine a building, *e.g.*, a ruined castle placed on the summit of a hill, so situated that from the opposite side of the valley the building is picturesquely set off by a distant range of mountains as a background. The telephoto lens enables us to deal with such a composition from the opposite hillside from some position approximately on a level with the building. To deal with the same subject with an ordinary lens we should probably have to attack it from some position on the same hill on which it was situated and from a point considerably below its level, with the very probable consequence that the hill on which the building stood would hide the desirable background of distant mountains and give us the building silhouetted against the sky. Moreover the necessary nearness of our second position would falsify the relative proportion of parts and the depressed view point would also result in other distortions of a very undesirable character.

Views of military positions can be obtained at such a distance that the camera is beyond the longest rifle range. Buildings situated on a hillside can be dealt with by a camera on the opposite side of the valley at or about the same level, and thus avoid the distortion which would result from photographing the building with an ordinary lens from a nearer, but lower, view point.

Architectural details, statuary and other like objects situated at a considerable distance above floor level can be dealt with from a greater distance,

and therefore with correspondingly less distortion than would result from using an ordinary lens.

Subscriptum.—The Editor desires to acknowledge the very great kindness of Mr. Charles E. Shea, who has not only allowed us to reproduce some of his really splendid examples of telephotography, but also has placed at our disposal some valuable practical notes from which we are permitted to extract the jottings in this section. We are sure that our readers will join us in very heartily thanking and acknowledging Mr. Shea's two-fold and much appreciated kindness and expert assistance.

Sundry Notes.

By VARIOUS CONTRIBUTORS.

FOCUSING is one of the chief troubles of the beginner with the telephoto lens. The following jottings on this matter are contributed by several experts.

Hurried Focusing. — Many photographers fail in their early attempts with the telephoto lens through focusing in a too hasty manner. They pass and repass the point of sharp definition without knowing it. To such it must be pointed out that a movement of one hundredth of one inch in the separation often means as much as a whole inch or even more on the camera rack. The focusing pinion of the telephoto lens requires the same deliberate and gentle touch as if it were the corresponding adjustment on a microscope. E. C.

Focusing Dodge.—A good deal of the difficulty of focusing is due to the feeble illumination of the ground-glass image. It is therefore of the utmost importance to prevent all daylight from getting under the focusing cloth. The best way to do this is to have the focusing cloth of opaque material, *e.g.*, thin waterproof twill. Let it be made in the shape of a tube with a slot round each end. In each slot is a ring of wide elastic like a large garter. One end of the tube is made just

large enough to embrace the back of the camera when the elastic has a medium pull. The other end should be large enough to admit the face, so that the elastic goes from the chin to the top of the head. This leaves both hands free, and *all* extraneous light is kept out.

Focusing.—Many workers find that it is much easier to see the ground-glass image of a dimly-lighted subject when the head is held as far away from the focusing screen as distinct vision will allow. This, of course, means a good large focusing cloth. A. G.

Unless the photographer is very sensitive as regards his *(or her)* personal appearance great benefit will be found in wearing moderately dark neutral tinted glasses. When these are removed under the focusing cloth the image on the screen will appear nearly as bright as it did to the eye. The avoidance of glare may also avert a headache, and thus further improve the chances of a successful photograph. E. C.

Aids to Focusing.—One of the difficulties of fine adjustment comes from the coarseness of grain of the ground glass. The telephoto user should bear in mind that there are degrees of fineness of ground glass, and that the finest acid-etched is greatly superior to the ordinary or sand grain. Ordinary ground glass may be much improved for our present purpose by rubbing the ground side with a trace of glycerine ; only just enough being used to give a slightly sticky surface and not enough to make it wet. C. E. S.

One of the most important things is to have a really fine-grain ground glass. Some workers recommend the acid-etched surface. The present writer prefers the finest sand-blast surface. If this be rubbed over with a trace of vaseline or glycerine its translucency is greatly increased, and yet the grain effect of the surface is not lost. Only just enough vasaline should be used to give this translucent effect. As dust particles are held by this damp and sticky surface, it should be cleared off and renewed at fairly frequent intervals. F. C.

Beginners often experience some little difficulty in

seeing anything at all on the ground glass on account of the diminution of light due to its being spread over a larger image. The eyes should be closed for a minute or so while the head is kept under the focusing cloth, and then they should be very *slowly* opened. This little dodge seems to greatly help the discriminative power of the eyes.

Again, with the finest ground glass one is apt to see the grain a good deal more than is desired, and with a feebly lighted image this is bothersome. If the camera be gently tapped so as to give it a little vibration, one then sees the image parted, as it were, from the grain.

A little experience will show us that it is much easier to focus an object in strong light and shade contrast than one in flat lighting. If a snowclad or sunlit patch in juxtaposition with some dark part can be found, it will greatly aid in this direction.

Focusing may be done in two ways, according to circumstances. Suppose the distance between the negative and positive lenses has been selected and then arranged, focusing is then to be done by shifting the ground glass. In this case one may often slowly move the ground glass an inch or so and yet not see very much difference. But if it be shifted to and fro as quickly as possible, it is then easier to see if we are making the sharpness better or worse. We then move it quickly in the direction that seems to make the image sharper until we notice it is getting less sharp; then quickly turn back until it has passed through the best stages and again is getting less sharp, each excursion to and from being less and less. In fact the operation seems to suggest the swing of a pendulum which is coming to rest, but which is going past its position of rest this way and that, with a diminishing swing each time, until it finally ceases to swing either way, and so comes to rest. At the same time it must be kept in mind that any alteration of this distance involves an alteration of the scale, or magnification. Therefore, if the photograph is required to show a predetermined and exact degree of magnification, this adjustment must first be made and then the final focusing done by the

camera rack and pinion. Where the operator is entirely free to select the scale, then the lens pinion method is the easier, better, and quicker method.

The second case is when the position of the ground glass is a fixture, and focussing is then done by the rack and pinion controlling the distance between the negative and positive parts of the system. As a very small turn of the screw makes a considerable difference in the degree of sharpness, one has to "go slow" and keep a very watchful eye on some particular bit of detail, such as a tree branch, a crack in a rock on the hill-side, the leading of a window. This second method is the easier, and generally to be preferred when the circumstances of the case permit it. C. E. S.

Another useful tip is to cement a thin microscope cover glass—a circle of about half-inch diameter is convenient—to the ground side by means of a drop of Canada balsam, thinned down with benzol or chloroform. A bit of a fly wing should be embedded in the balsam between the ground glass and micro cover so that the focusing eye-piece may be adjusted for this at any time. Failing the fly's wing we may use a pencil mark made with a fine point of soft lead. Three such covers may be put on the ground glass, *i.e.*, one central, one in the right or left upper corner, *i.e.*, for the near foreground, the third, about midway between the other two. When arranging the picture on the ground glass the eye soon learns not to see these circles until they are required for final adjustment.

Another, but less convenient method, is to have the ground glass in two pieces, so fixed that they leave a strip or gap of about half an inch running across the middle of the picture space. The focusing eye-piece resting on the two positions of the focusing screen views the aërial image in the gap.

Yet another method is the employment of a piece of clear glass in place of the usual focusing screen. This method enables us to see any part of the image by means of the focusing eye-piece, but unfortunately we are not able to see our picture

as a whole as we can with either of the ground-glass methods.

In all cases it is *desirable* to focus with the lens in the condition in which it will be when the exposure is made, *viz.*, with the stop, colour filter and sky shade *in situ.*

As, however, under these conditions the light *may be* reduced to such a small quantity that focussing becomes difficult in practice, there will be found no disadvantage in focusing with full aperture and afterwards stopping down ; any error caused by spherical aberration will be less than that caused by inability to see the image on the screen. E. C.

Owing to the loss of light, due to the relatively small aperture (and colour screens, if one is about to be used), the beginner may experience some difficulty at first in seeing anything at all on the ground glass. But if he will get his head under the focusing cloth and keep his eyes shut for a minute or minute and a half and very gradually open the eye-lids, he will then find that this optic nerve rest has now enabled him to see much more than was at first possible.

If a focusing eyepiece is used, this should be fairly strong, so that its depth of focus may be small ; otherwise the eye lends a measure of accommodation which is not wanted on this occasion. One need hardly add that the focusing glass should be carefully adjusted for the thickness of ground glass and sight of the user. This may most easily be done by making a few pencil-marks on the ground side, and adjusting the glass so as to see the granularity of these marks when it (the focusing glass) is in contact with the smooth side. Others prefer to use a few fine fibres of cotton wool held close to the ground side by means of a piece of clear glass. A. R. D.

It is necessary to use a high power eyepiece for aërial focusing, as with low powers there is too much "depth." As a rule young people fail when focusing upon clear glass, while those of more mature age, say sixty or over succeed. This is due to the fact that in the latter case the muscles which

Fig. 19 (p. 63). F. C. L.

From same stand-point as figs. 17 and 18, with Moderate Power Telephoto Combination

Fig. 20 (p. 63). F. C. L.

Fountain, same height as in fig. 19. Taken with Ordinary Lens from a near position.

control the focusing or "accommodation" of the eye have become to a great extent inoperative.

E. C.

The Camera for telephoto work deserves a few moments' consideration. All things considered the present writer recommends a size not greater than half-plate and not smaller than quarter-plate, with a decided preference for the half-plate size as getting the best average qualifications. It should have a bellows length of not less than three times the long side of the plate, and at times a further elongation will be found of great value. But for all-round work one does not often want a magnification greater than five or say six diameters.

Now a six inch positive lens with a three inch negative attachment gives us six magnifications with fifteen inches back focus, so that an eighteen inch bellows would meet this case for distant objects, or if we prefer to use a seven inch positive with a three inch negative lens and a separation of four and a half inches, we shall get the same equivalent focal length and a back focus of fifteen inches.

But what is far more important is general rigidity. For good telephoto work there must be rigidity as regards both the lens and plate. In other words the back and front of the camera must be capable of being *rigidly* fixed relative to the baseboard (and, of course, the camera must be equally firmly fixed to a very steady tripod). An extra degree of swing will be needed for the camera back if the worker is going to specialize in architectural work, because he is likely to tilt his camera at a considerable angle when dealing with detail pictures of objects considerably above ground level. But apart from this class of work no extra swing is likely to be wanted.*

Should the reader possess one of the older-fashioned solidly-made folding cameras, let him not discard it because it has not got a long bellows extension, for it will be a very simple matter to get made an extension front in the shape of a truncated four-sided pyramid. This will give any extra length required, and the extra ounces of weight will be

*For a tilting arrangement see *The Practical Photographer*, No. 12, Architectural Photography, p. 17-18.

worth carrying when he remembers that the old and heavy camera has the valuable property of rigidity. Moreover a moderately heavy camera is not so likely as a light flimsy camera to suffer from vibration in a wind. A rising front is very desirable, but a swing front, though useful at times, is not essential.

When selecting a camera for telephoto work the "parallel bellows" or "square long extension" pattern should be chosen. This pattern is now made nearly as light as the conical patterns, and is most convenient for every class of photography.

E. C.

The Tripod for stand work with telephoto lens should be as firm and rigid as possible under the circumstances. As the image is extra large there should be corresponding extra care taken to guard against tremors or vibration of any kind. Most of the tourist tripods of present-day manufacture are far too flimsy for telephoto work, and especially for out-door use where there is frequent probability of disturbance by wind. When setting up the tripod let the legs have a good spread, and whenever possible let the points be firmly thrust into the ground. For interior work the floor should be covered with a large rug, carpet, or mat, and each leg secured by a piece of tape, and all three tapes brought together and knotted midway between the three legs.

A sliding strut running from the middle of the front leg of the tripod to the front of the camera tripod is extremely useful, and is usually so arranged that it "runs free" until all other necessary adjustments have been made, after which it is clamped. E. C.

For Large Camera Work some workers use a fourth tripod leg—quite independent of the other three—to support the lens. Others use an extra long baseboard and two separate tripods. Others again employ slotted side struts connecting the front and back of the camera.

One of the best ways of securing rigidity between the front and back of the camera is by means of two slotted bars as shown in the accompanying

fig. 51. One end of one bar, A, is fixed by a screw nut to the centre of the top of the back of the camera. The opposite end of the other bar, B, is

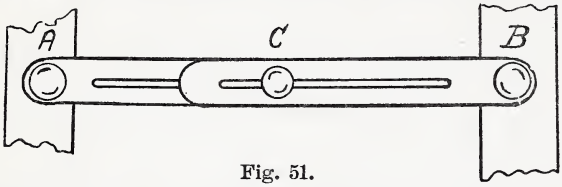


Fig. 51.

similarly fixed by a screw nut to the centre of the top of the camera front, and the overlapping slotted part is firmly held by a clamping nut, C, about their centre.

Plates.—It may be said that a backed plate is never a disadvantage, and on most occasions, if not always, it is a distinct advantage. Again, orthochromatic plates will do all that ordinary plates will do, and when used with suitable colour filters they will do a great deal that ordinary plates will not do. Hence a backed ortho plate is a reserve of power that can do no harm and may be a great advantage.

All things considered a generously coated plate of moderate rapidity, say 150 or 200 H. & D., is better than a thinly coated plate of 300 H. & D. For good gradation, combined with delicacy and clearness in working, a generously coated plate of moderate speed has much in its favour. Slow plates are not desirable for telephotography as the prolonged exposures increase the risk of vibration troubles. A. M.

Development of tele-photo negatives calls for one word of caution, *viz.*, that it often happens that the negative has a slight general fog veil all over it. The beginner may very easily be misled by this into thinking that the negative has either been light-fogged in the dark-room, etc., or that the fog veil is an indication of excessive exposure. He must learn to discount this fog veil and carry development just a trifle further than usual, and then after fixing this fog veil may be removed by the hypo and ferricyanide reduction. The negative is passed direct from the fixing bath into this reducing

bath, as this procedure practically excludes all likelihood of staining. [On this point the reader may advantageously consult No. 7 of this present series, "After Treatment of the Negative." *Sub.*, Reduction.]

If, however, the worker is prepared to give a little extra time and attention to the printing of his negative, he had better leave the fog veil alone and print his negative in strong but diffused light. Or, if printed in the sun, then the face of the printing frame should be covered with a piece of ground glass. In this way he will probably get a soft result of better quality than he might anticipate by merely looking at his negative and judging it by his other fogless negatives.

Of course, the worker will—in telephoto work just as in all other kinds of photography—bear in his mind the degree of light and shade contrast in the original subject, and give a short, medium or long development according as he wants a soft, medium or strong contrast result.

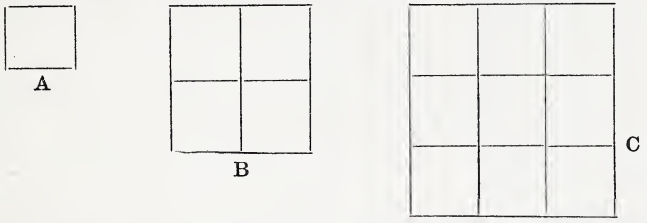
It is quite a mistake to suppose that all telephoto negatives must have strong contrasts and give black and white prints. Softness or hardness is a matter of lighting of the subject, exposure and development just as in all other kinds of work.

Exposure.—If it is always important and worth while to spare no pains to secure a satisfactory exposure, it is especially the case in connection with telephotography. And in this connection there are several factors to which the beginner is now invited to pay special attention, because they are likely to escape his notice when working with ordinary lenses of moderately short focus.

Now exposure depends upon the quantity or intensity of light. So that if in one case we have a certain quantity of light falling on a given space, and then in another case have an equal quantity of light spread over a larger space, it is clear that in the second case we must give more exposure than in the first case.

Supposing now that we spread the same quantity of light over a space four times as large in the second as in the first case, then if one second ex-

posure is correct for the first case we must give four seconds in the second case.



Suppose A to represent a picture just one inch square, B to represent a space two inches long and 2 inches wide, *i.e.*, four spaces each one inch square, and C a space three inches long and three inches wide, *i.e.*, equal to nine spaces each of one inch square.

Thus if the picture A be enlarged to fill the space B the corresponding exposures would be as 1 to 4, but if A be enlarged to fill the space C, *i.e.*, enlarged three times each way the exposure would be 9 times that of A.

Hence we get the familiar rule that the exposure increases as the square of linear magnification.

Suppose then we have made a satisfactory exposure (10 seconds say) with a magnification of 4 times, and we wish to repeat the same or a similar subject with 7 times magnification, we can easily see that the relative proportion of the two exposures must be as 4×4 (16) to 7×7 (49). So that our rule of three is 16 : 49 :: 10 to required time for 7-fold magnification, *i.e.*, $30\frac{5}{8}$ seconds. Now this rule of relative exposures is all very well so long as we are comparing similar subjects under similar conditions. But suppose that one subject be a distant snow-clad mountain range, and the other some dark building only a few hundred yards away, then it would be found quite misleading.

The fact is that different classes of subject call for various departures from this fundamental rule. And the reasons for these departures are not very far to seek.

Distant Landscape Mountains, etc.—Suppose by way of concrete example that we first take a negative with our six inch positive lens with *f*/16

and find an exposure of $\frac{1}{50}$ second satisfactory. We now add our 3-inch negative lens and arrange for a magnification of 5 times. Our rule would tell us to increase the exposure by 25 times (5×5), *i.e.*, to give $\frac{1}{2}$ second. But before doing this let us take a second and general glance at our ground-glass picture, when we shall notice that the light and shade *contrasts* of the hills on the enlarged scale do not seem so well marked as they did on the smaller scale. In fact, we shall find that $\frac{1}{2}$ a second would be rather too much exposure and we should get a better result by cutting down the exposure to about one half that which the general rule indicates, *viz.*, by giving $\frac{1}{4}$ second rather than $\frac{1}{2}$ second. It will be understood that in the case of distant landscape with softened contrasts due to the intervening atmosphere we may regard our standard rule as giving us the maximum, which we may cut down to $\frac{2}{3}$ or $\frac{1}{2}$.

Now let us take a subject quite opposite in character. Suppose this to be a bit of carved stonework or similar architectural detail in a well-marked (but not excessive) contrast of light and shade. And suppose that with our ordinary lens we find 1 second exposure sufficient and generally satisfactory. Adding our negative attachment we again arrange for a magnification 5 times, which by our rule would increase the exposure 25 times. But if we gave our large scale negative 25 seconds we should probably find our picture disappointingly black and white and generally suggestive of under-exposure in this instance. Now the reason is this. In the small scale picture we have a large number of *small* (space) strong lights and strong darks, and these spaces being small our eye does not look for much detail or gradation in either the light or dark spaces. But when we enlarge these patches of light and dark to 25 times their original area they are no longer small spaces, consequently the eye expects to see detail in the shadows, and gradation in the lights. In other words, our rule in this case is giving us the minimum exposure and we may advantageously increase it to double or even more.

Now let us take an intermediate case, say that of

Fig. 21 (p. 63).

Mid-distance Architecture. Taken with Ordinary Lens (cf. Fig. 22).

Fig. 22 p 64).

Taken from same standpoint as Fig. 21. Telephoto combination, moderate power.

a portrait or animal study in soft diffused light. In such a case where our subject is not characterized by vigorous contrasts on the one hand, or very delicate differences of light and shade over a large part of the subject on the other hand, we shall find our rule to work admirably.

With these three examples in mind, the reader ought to be able to grasp the principles of the matter, and so be enabled to modify the rule governing exposure according to his special requirements. But let him be warned not to depart from the rule-given time unless he is quite clear in his mind as to why he is departing from it, and also let him be advised that it is better to make too little than too much departure from the rule.

We are now in a position to pass on to the consideration of the lighting of our subject, for we have just seen its importance.

Lighting the Subject.—We must bear in mind one fundamental principle, *viz.*, that the larger the scale of our picture the broader (less patchy or spotty) it is. This for the very simple reason that the small patches of light and dark, so noticeable in most small scale pictures, are less noticeable when of larger size, and also the quantity of light in the small-sized patch is in our larger picture spread out, and so less intense in the large scale picture.

Now while breadth is a highly prized quality in pictorial work, flatness or lack of gradation is far from desirable.

General experience goes to show us that we get the best general breadth of effect when the sun is to our right or left, *i.e.*, the chief light falling on our subject in a direction at or about at right angles to the line of sight or axis of the lens. If the sun is too near our back we shall get flatness and a general absence of the quantity of shadow to give good light and shade balance. If the sun is too much towards our face we shall get too much dark for good balance, and at the same time often a suggestion of silhouette-like flatness.

In general terms, the nearer the subject the softer the contrasts should be. Because the atmospheric absorption, or aërial perspective as it is often

called, softens the light and shade contrasts of strongly-lit distant scenery.

For portraiture with the telephoto lens one should aim at a tendency towards softness rather than vigour of lighting.

Flowers, small animals, and other small objects may have a moderately vigorous range of light and shade contrasts. H. R. H.

Atmospheric Conditions.—Curiously enough any variation from what we may call normal atmospheric conditions, either in the direction of abnormal clearness or haziness, seems to be exaggerated. It is, therefore, not uncommon to see some telephoto pictures of distant mountains without any signs of atmosphere at all, and others of less distant scenery which seems enveloped in a general haze. The only way to mitigate the state of exceptional clearness is to put the image *very slightly* out of focus, and so suggest the influence or effect of atmosphere, so that the spectator may not be prompted to notice its conspicuous absence.

Haziness, on the other hand, may often be reduced—first by paying great attention to screening the front lens from any direct light by means of some form of hood or lens shade. Or, if nothing of the kind be at hand, one may get a friend to hold an umbrella or hat so as to cast a shadow across the lens and yet not get in the way of the view. Sometimes one can make a similar use of a shadow cast by a building or tree. Haziness also may easily arise from general diffused light (not direct sunshine), and especially when the source of light is in front of, rather than at one side of, the line of sight.

It is a matter of common knowledge that a very pale yellow screen will have a very considerable influence on reducing light haze. Such a screen need be no darker than enough to double or treble the exposure with an orthochromatic plate. And in connection with this topic it may here be said that the use of a too-dark yellow screen is one of the common mistakes in connection with distant landscape work with a telephoto lens. The effect of such over dark screens is to rob the scene of its suggestion of atmosphere and distance and to

suggest toy scenery. It should be noted that in the midsummer months we are more likely to get haze about the mid-day hours, so that for moderately clear atmosphere the camera-ist should be at work at least three hours before mid-day.*

Wind is always troublesome to the tripod photographer, but this is especially the case when a telephoto lens is being used. Often the camera is at a long extension, and as the scale of the image is large any slight vibration is fatal to sharpness. We must therefore do our best to *support the camera* firmly—*i.e.*, use a firm and rigid tripod—and also *protect the camera* itself from the influence of the wind. The tripod points should be well spread out, *i.e.*, apart from each other and thrust well into the ground. Or if that be not possible, the tripod head should be held firmly down by means of an elastic band fixed to the tripod head and kept taut with the foot. The focusing cloth should be wrapped *tightly* round the camera and held firmly by bands of broad elastic, so that there may be no flapping corners or folds under which the wind may find its way. The operator's body—or an umbrella—should be interposed between the wind and the camera so as to shield the latter as much as possible.

It is on windy days that one feels the advantage of a firm and small camera, hence one reason for advising that the size may not exceed half-plate.

A well-made moderately heavy camera is not so likely to suffer from wind vibration as a lightly-built, cheaply-made camera.

As the exposure may take several seconds, it is advisable to use such a form of shutter as can be opened and closed again and again by means of a pneumatic tube and ball, so that the exposure may be cut up into short intervals during the lulls of the wind.

Telephoto Lens in Portraiture.—For purely pictorial purposes one does not want anything like sharp definition in portraiture. In fact in the opinion of the best exponents anything like crisp-

*Some workers prefer the hours towards sunset as being freer from haze, and the yellowish light renders a colour filter unnecessary.

ness of definition is intentionally avoided, and many expedients are employed to gain that end. It therefore would appear that there is room among portraitists for a quite cheap telephoto attachment which could be quickly added before or behind the lens.

The kind of lens required is one which would give

1. A general softness of definition when used in conjunction with an ordinary R.R. lens.
2. A magnification of say 2 to 4 times linear.
3. A fairly wide field of view, *i.e.*, sufficient to include head and shoulder portraits at low magnifications.
4. As little reduction of light on the focusing screen as possible. F. C.

Definition of a Telephotographic Lens.—Strictly speaking, a Telephoto Lens is one which is of relatively great focal length in relation to the size of the plate upon which it is used, but by common consent the term is now confined to lenses which have a much greater focal length than the camera extension, at which they produce a sharp image, and such lenses are almost without exception composed of an anterior positive and posterior negative lens, with some convenient means of varying the amount of separation between them. E. C.

Telephoto Attachment is the term usually applied to a negative lens (or combination) placed between an ordinary photographic objective and the plate.

Adon.—This form of telephoto combination is put in front of an ordinary objective. Its general design is similar to that of an opera glass and it may be used in that way.

The Adon Lens.—The Adon lens fitted to a reflector camera, without which its usefulness is much dimished, may be used in two ways. It may be attached in front of the ordinary lens, in which case the image will be magnified about 2 diameters, while, marvellous to relate, the whole combination will be working at or about the aperture of the positive lens. This, of course, would get over the exposure difficulty altogether, and would be the very ideal of Telephotography, were it not for the very slight magnification secured, scarcely more than can be obtained with any long-focus camera

by using the single combination of the lens, and also for the unfortunate fact that when used in this way the Adon does not cover the corners of the plate; this limits its usefulness to such pictures of animals, birds, ships, etc., as may afterwards be suitably masked by a circle; and in any case, the single combination, if it works at any fair aperture, will usually be found more satisfactory.

But the Adon, used by itself, is quite a different instrument and a far more efficient one. With the camera extended 5 inches it is a 14 in. lens working F/13 and covering a quarter-plate; extended to 8 inches it becomes a 20 ins. lens working at F/20 and covers a half-plate, and so on, the only limit to the magnification obtained being the distance to which the camera can be racked out. When using it on a Reflector camera it is as well to mark off the baseboard, or the extension rack, in inches, and against each inch to put, not the amount of camera extension, but the F. value of the Adon when that particular point is reached. This simple expedient, besides avoiding the use of a tape measure and perplexing computations, converts the Adon into nothing more formidable than any ordinary lens so far as exposure calculations are concerned.

How to focus.—The Adon is quite capable of giving a sharp image at full aperture, but to do this it needs to be very carefully focused indeed, and there must be absolutely no vibration during the exposure. The image seen in a reflector is never quite so bright or clear as the direct image on the focusing screen of a stand camera, and it is not always easy to focus with exactness and certainty. It is the same thing as trying to focus with a lens stopped down to F/16 or F/32 as the case may be without the aid of a magnifier.

The best plan is to focus on some clear bright object, if such can be found, at about the same distance as the subject. If this cannot be done, the next best thing is to throw the image equally out of focus each way and try to get the middle point. It is of little use to stop down the Adon in hopes of getting greater sharpness, unless the principal object at all events, has been correctly focused;

small apertures will not atone for slovenly focusing in this sort of work.

Exposure.—The exposure necessary to avoid vibration will vary with different workers. Probably there are not many who can hold a camera steady enough to give $\frac{1}{5}$ second with a telephoto lens working at any great magnification, but $\frac{1}{25}$ second should be fast enough for the most breathless mortal. With any ordinary quarter-plate or 5×4 reflector camera, the Adon will be found to be a lens working usually at F/20 to F/30 according to the amount of extension. The longest exposure advisable for hand work is perhaps $\frac{1}{10}$ second. A glance at any exposure tables will show what possibilities this offers. Of course neither slow plates nor yellow screens must be used, nor must the Adon, except under very exceptional circumstances be stopped down, but with these limitations it will be found quite practicable to make exposures on any subjects which have not a strong foreground in summer sunshine; while distant objects and beach and seashore scenes can be taken in much poorer light. A. L. B.

The Choice of a Telephoto Lens.—The first impulse of a beginner in telephotography is to procure a lens or attachment of the highest possible power, but unless his work be of some special character he will probably soon repent his choice, and perhaps even abandon this class of work altogether. For ordinary amateur, and even for most professional work, a magnification of from 3 to 7 diameters will be found most generally useful. As some guide to the choice of a negative attachment it may be pointed out that the foregoing magnifications are usually to be obtained within the limits of ordinary long extension cameras, by employing a negative lens with a focal length of about half that of the anastigmatic or rectilinear which is to be used as the positive element. Thus, supposing one wishes to convert an 8 inch R.R. into a telephoto lens, a 4 inch negative should be chosen, as such combination will just cover the half-plate with a magnification of 3 diameters. with a camera extension of 8 inches, while with an extension of 24 inches, which may be

Fig. 23 (p. 64).
Open Landscape, taken across a sheet of water with Ordinary Lens (cf. Fig. 24).

Fig. 24 (p. 64).
Same subject and same standpoint as in Fig. 23, taken with telephoto combination, cf. Fig. 23.

obtained with some of the modern types of camera, the considerable magnification of 7 diameters is possible. This range of magnification may seem to be small, but if one will consider that a house which is depicted by the ordinary lens as the size of a penny stamp, with a magnification of 7 diameters will cover over four shillings worth of stamps, or in other words it would just cover the half-plate.

For special work higher powers are often necessary, and the proportion of the focal lengths of the negative and positive lenses may be as high as one to four or even more. On the other hand for pictorial landscape work and portraiture very low powers are necessary, and the focal lengths of positive and negative lenses may be equal. In such case, of course, there is little range of magnification, about $1\frac{1}{2}$ to $3\frac{1}{2}$ times being the practical limit.

E. C.

Stereoscopic Telephotography.—Stereoscopic pictures are made with the telephoto lens in much the same way as with ordinary lenses, and for comparatively near objects a pair of lenses may be used. There is, however, very great difficulty in getting the two images of equal size and sharpness, so that when the subject will permit, better results will be obtained by making successive exposures with the same lens on the two halves of the plate. For flowers and natural history specimens this may be done by means of the ordinary "cross front" of the camera, which should be long enough to allow the lens to be placed opposite the centre of each half of the plate without allowing light to enter at the ends, the camera being firmly fixed in one position. For distant views the camera must be shifted to a distance of from one yard to several hundreds, taking care that the same object occupies the centre of the plate and that the camera is accurately levelled for each picture. For this class of work a binocular camera is not necessary, as the two pictures may be made on separate plates or successively exposed on a spool or film. It is, of course, understood that the image must not be refocused for the second exposure, but only properly centred on the plate. E. C.

Telephotography with a Hand Camera.—This,

of course, means such a period of exposure as may be given without shifting the image on the plate. We may put this down as $\frac{1}{10}$ second as a working maximum limit. This in turn will call for (1) a well-lighted subject, *e.g.*, distant open landscape, snow scenes, sea and lake scenery, etc.; (2) a rapid plate; (3) a positive lens of large aperture, say, not less than *f*/8 and preferably something larger *(e.g., f/6)*, and a magnification not more than, let us say, four times. Because we must bear in mind that the increase of exposure varies as the *square* of magnification.

Thus if our telephoto exposure be $\frac{1}{10}$ second, this would (with four times magnification) correspond to $\frac{1}{16} \times \frac{1}{10}$ second, *i.e.*, $\frac{1}{160}$ second with the same positive lens and stop. With a magnification of five times it would correspond to $\frac{1}{25} \times \frac{1}{10}$, or, $\frac{1}{250}$ second.

The Finder is of extra importance in this connection. The ordinary finder is already too small to be relied upon, and when we have to cover up say three-fourths of this, so as to leave the part given by a four times magnification, its use is reduced still further. In fact the ordinary finder under these conditions is little or no use as regards showing us how much of our picture will be included on the plate, and only serves as a better-than-nothing guide for aiming at what we wish to get in the centre of the plate.

Then, again, by altering the equivalent focal length of our telephoto combination, we are thereby altering the quantity of the view included from the same standpoint; so that, here again, if we mark our finder to suit any one degree of magnification, it obviously will not be correct for any other degree of magnification.

There are two chief ways out of the difficulty, *i.e.*, that of having two finders; one which gives the angle of view of the positive lens only, and a second larger scale finder giving the angle of view corresponding to the lowest degree of magnification when the telephoto attachment is in position. The other higher degrees of magnification are then indicated by lines on the finder.

The other, and perhaps all things considered, the

better method, is the use of a full-sized, or nearly full-sized finder such as is provided with cameras of of the "Reflex" type. This plan has also the further advantage that focusing can be done at sight right up to the moment of exposure—a matter of great importance with moving objects. T.S.

The Question of Focusing is one calling for extra care, for the simple reason that the longer the focal length of a lens system the less depth of focus we get, and in the case of telephoto combinations, a very slight alteration of the distance between the negative and positive combinations of the system makes a vast difference in the degree of sharpness of the picture. Hence, the generally unsatisfactory nature of focussing by a scale which calls for a rapid and accurate estimation of the distance of the chief object. Moreover as the distances we are called upon to guess at in these connections are usually considerable, it is all the more easy to make mistakes. Then, again, the telephoto system is often used for a view across a valley or over water, when it is extra difficult to guess distances of this nature.

Usually telephoto snap-shots are taken at a greater distance than the hyper-focal distance of the lens, so that if the infinity point for a certain camera extension is accurately marked upon the tube, no focussing is necessary. An excellent plan for snap-shot work is to keep to one degree of magnification as far as a fixed extension will allow, and to focus with a scale marked on the tube of the telephoto lens. E. C.

Carrying the Camera. Bearing in mind that we are dealing with slow exposures and large-sized images, the steadiness of the camera also calls for extra attention, and as one hand at least is required for focussing and exposing, the other must be quite free for steadying the camera. All things considered, there is perhaps most to be said in favour of slinging the camera by means of a strap passing over the back of the neck and holding the camera resting against the "nether-chest."

There is something also to be said for making the exposure by means of bulb and tube, holding the bulb between the teeth and exposing by giving a

sharp bite, as this plan leaves the two hands free to steady the camera against the body.

History of the Telephoto Lens.—Although the Telephoto Lens, as we know it, is of comparatively recent introduction, the first lenses having been sold in 1891, the idea of projecting a magnified image by means of a concave lens is older than photography itself, as will be seen from the most interesting and valuable paper read by Major-General J. Waterhouse before the Royal Photographic Society, on December 10th, 1901.

This authority considers that the foundation of our modern system of Telephotography was laid by Kepler in 1611, and practically lost sight of until Porro revived it about 58 years ago and adapted it to photographic work. The negative lens which Porro used for the purpose of photographing an eclipse was a concave amplifying lens of the form introduced by Peter Barlow in 1834, and familiar to all astronomers as a means for securing a higher magnifying power in a telescope without lengthening the tube.

In 1873, Mr. J. Traill Taylor detailed some experiments which he had made, using one barrel of an ordinary opera glass in place of the ordinary lens. The results obtained were interesting rather than practically useful. In 1890, Steinheil constructed, for the German Government, a telephotographic apparatus, of which no details were available, and in 1891 patents were almost simultaneously applied for by T. R. Dallmeyer in England, October 2nd, and Dr. Miethe in Germany on October 18th. The first public demonstration of the powers of the telephoto lens was given by Mr. Dallmeyer before the London Camera Club on December 10th of the same year. The instrument then shown was composed of single cemented positive and negative lenses, and was termed "a simple telephotographic lens." This lens was followed in March, 1892, by Mr. Dallmeyer's Compound Telephoto Lens, in which the method, now generally adopted, of using an ordinary compound photographic lens as the positive element with a negative element composed of two cemented combinations with a small central air space. Much

greater rapidity is obtained by this construction, besides an almost entire absence of distortion and a greatly increased flatness of field.

The latest comer in the field is the little "Adon" lens, also the invention of T. R. Dallmeyer, which is the first telephoto attachment adapted for use *in front* of the ordinary lens. At first sight this may appear an impossibility, but it should be remembered that the "Adon" is in itself a complete telephoto system consisting of a front lens which is positive or image-forming and a back lens of sufficient power to neutralize the lens already fixed to the camera, and still impart a negative character to the entire back combination. When the Adon is so employed the field is necessarily small on account of the cuttiug down of the image circle by the mount of the positive lens and the magnification is not more than $2\frac{1}{2}$ diameters, but it has the valuable property of rapidity, an intensity of $f/8$ being available when the Adon is fixed on a 6 inch lens, while greater and less intensity is secured with lenses of less or greater focal lengths. The Adon is, however, generally employed as an independent lens and its powers are then only limited by the introduction of diffraction phenomena, or the length of exposure necessary with high magnifications ; a 15×12 plate can easily be covered before the theoretical limit ($f/71$) imposed by the appearance of diffraction is reached. The *Junior Adon* is a smaller variety of the Adon and is intended for use with Folding or Pocket Cameras, the front combination of their lenses being removed and replaced by the Junior Aden; better covering power is obtained by this form while the original intensity of the positive lens is fully maintained.

The Dallmeyer Bergheim Lens.—In 1893 Mr. J. S. Bergheim made some original experiments with combinations of single uncorrected positive and negative lenses, with a view of "suppressing unnecessary detail and aiming at a 'quality' in definition which he deemed better than that given by corrected lenses." He placed the results in the hands of Mr. T. R. Dallmeyer who developed the idea into practical form. The merits of this lens are not all due to its telephotographic construction

but the improved "drawing," obtained by the possibility of using a more distant stand-point, is not the least of them.

The Telephot.—Although of a totally different construction, this instrument deserves mention. There is no magnifying device, a positive lens of great focal length being used and the image reflected twice by plane mirrors inside the camera. Thus with a box 14 inches long, a lens having a focal length of 42 inches may be used.

Excellent results have been obtained with this apparatus, but the cost of the plane mirrors, which must be of excellent quality, have prevented its general adoption. E. C.

Cautions, &c.

Dirty Lenses are a frequent cause of failure in telephotography. Owing to the increased number of reflecting surfaces present in the tele-objective, great care in keeping them free from all dust or cloudiness becomes necessary. Lens surfaces should first be dusted with a camel-hair brush to remove any particles of grit and then wiped with an old silk or cambric handkerchief. If the surfaces still look smoky one or two drops of *absolute alcohol* should be placed on the surface which is then immediately wiped and polished as before. Some of the earlier negative lenses are burnished in their cells so that they cannot be separated for cleaning. If these are returned to the makers they will clean them for a few pence. It is better, however, to have them remounted in a separable cell, which will only cost two or three shillings and save further trouble.

Chromatic Error.—Some excellent lenses, even including expensive modern types, have a small residuum of chromatic error, too small to be noticed in ordinary work, but appreciable when the image is magnified. If, therefore, an image, which appears sharp on the screen, does not come sharply in the negative any of the ordinary tests for achromatism should be applied, both to the entire combination and to the positive lens alone. Under some conditions of separation a chromatic error will be introduced even when both positive and negative

Hold this picture at arm's length and well up above the level of the head.

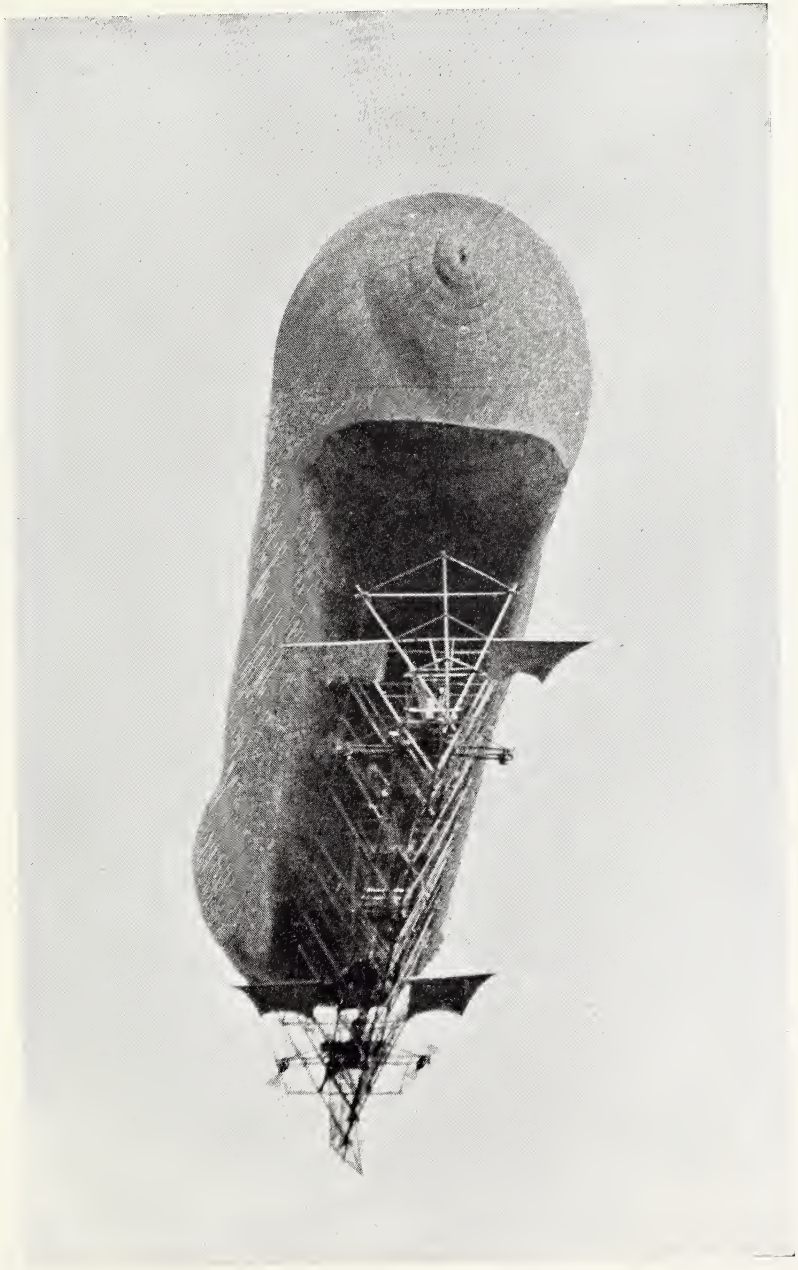


Fig. 25. E. Clifton.

THE BARTON AIRSHIP.

Taken on its trial, and only, trip (Aug. 1905, 5 p.m.), with a folding pocket camera and Junior Adon lens, exposure $\frac{1}{100}$ sec.

The airship was moving rapidly at the moment of exposure.

lenses are achromatic; in such a case colour fringes are usually visible and the focussing should be done so as to leave a white object with an orange or reddish fringe round it. These troubles are usually only present when working at high magnifications.

E. C.

A few words of advice to the beginner.

1. Do not commence operations with very distant objects, *e.g.*, Alpine views, clouds.
2. Do not use a magnification of more than four diameters.
3. Do not begin work with moving objects, or any subjects which especially call for the use of ortho-plates and colour filters.
4. Do not select a windy or a hazy day for first experiments.
5. Spare no pains to get as accurate focus and exposure as possible.
6. Do not over-expose and do not under-develop. A slight general fog appearance in the developer does not necessitate a lost plate.
7. Do not judge the negative until it has been printed.
8. Until some considerable experience has been gained it is desirable to make the exposures in pairs: the first is made with the positive lens only, the second is made with the telephoto combination. The same stop should be used in each case. A careful note of each exposure should be made and note-book entry made at the time, thus:—

No. 95. Slide 3. June, 11 a.m. Sunshine. Mudwich Church from N.W., 500 yards. RS., 6 in., *f*/8. Exp., $\frac{1}{30}$ sec. Plate Speed, 200 H. and D.

No. 96. Slide 4. June, 11-15 a.m. Sunshine. Mudwich Church as in No. 95. Telephoto, Mag., 4, *f*/8, nominal. Exp., $\frac{1}{30} \times 16$, say $\frac{1}{2}$ sec.

Notes on some of the Illustrations.

Fig. 9. **Portrait.**—This is an extreme case of the use, or rather misuse, of a lens of rather short focal length used at too great a distance from the sitter. The exposure was $\frac{1}{5}$ sec. with *f*/8. It also illustrates another common fault, *viz.*, that of having the camera too much above floor level for a

full length figure, and so giving the floor somewhat of an uphill effect.

Fig. 10. **Portrait.**—This is the same sitter as in the last study. By adding a telephoto attachment to the lens previously used, a magnification of something like seven diameters was obtained without altering the position of the camera. The same stop—*viz.*, *f*/8—was used for both exposures. Theoretically the exposure should have been increased 49 times, so 10 seconds was given.

Fig. 17. **Landscape Study.**—This diagram subject was chosen as it included a considerable stretch of road way, a middle distance object (the fountain) of a size easily measured on the focussing screen, and a background of foliage. Taken with a stigmatic lens of about 6½ inches equivalent focal length on a half-plate, stop *f*/11, exp. ⅛. This and the three following form a series of connected studies especially taken to illustrate certain important points in telephotography. The following conditions apply to all four.

May. Sun and wind. A medium speed plate. Time between 12 and 1 noontide. It should be carefully noted also that the first three figs., 17, 18, 19, were taken without moving the camera. In the fourth example, fig. 20, the camera was brought up to within a few yards of the fountain.

Fig. 18. **Landscape Study.** This shows the application of a 3 inch telephoto attachment to the above-mentioned lens of about 6½ inches focal length. This is the lowest magnification that the mounting of these lenses will at present give, and is just a trifle over 3 times linear, necessitating a nine times increase of exposure. It will be at once noted that under the conditions of using, the lens does not cover the plate. Hence the dark corners. The dark spots on the road way are London sparrows, and not defects in the plate, which shows signs of under-exposure. The under-exposure was due to a sudden gust of wind coming at the moment the cap was taken off. The flatness of the step courses at the base of the fountain should be noticed in this and the next example.

Fig. 19. **Landscape Study.**—This shows the result of a magnification of about 5½ times. The

lens now amply covers the plate to the corners. The gusty nature of the day will be recognised by the detailless nature of the foliage background. The reader will probably notice the flat, silhouette, reliefless look of the fountain, although its details are thrown into strong contrast by a gleam of bright sun. This peculiar perspective effect is one of the chief difficulties in applying these lenses for purely pictorial purposes. Magnification about $5\frac{1}{2}$ times linear.

Fig. 20. **Landscape Study.**—For this negative the camera was moved up towards the fountain until the height of this structure on the ground glass with the stigmatic lens alone was the same as that with the telephoto arrangement at a distance gave a magnification of some $5\frac{1}{2}$ times.

It will be well worth the reader's while to compare these two results, among other things noting the following. The point of view in the latter is a little more to one side than in the former. In the former the background of trees seems nearer and also taller, although the slight difference of position should tend to show the tree background not so high. In the latter the trees seem to fall away in size very quickly. In the former the step courses at the base seem horizontal and flat; in the latter we see more of their surface, and generally the ground seems not so flat but somewhat tilted up. In the latter the whole structure seems to suggest a slight falling backward, although the swing back was carefully adjusted. To sum up, these two lenses of equivalent foci, $6\frac{1}{2}$ and say 36 inches give us results bordering on the two extremes in opposite directions.

Fig. 21. **Architectural Study.**—May. Sun and wind. Noon. Lens of $6\frac{1}{2}''$ focus, $f/16$, exp. $\frac{1}{8}$. A somewhat commonplace example of a park side terrace. It was chosen to show that the group of figures in the pediment could be easily seen and photographed from a little distance. But had the camera been approached towards the building in order to get a large scale picture of the pediment with an ordinary lens, various trees would have been in the way. The camera would also have to be tilted, and even then the well-known unpleasant

effect of looking up at part of a building would have been inevitable.

Fig. 22. **Architectural Detail Study.**—This is a small part of the previous picture on an enlarged scale, taken from the same standpoint with the help of a telephoto combination. The magnification is about five times linear, suggesting an augmentation of the previous exposure some 25 times. But this theoretical 3 seconds was, for reasons which need not now be discussed, reduced to 2 seconds, with a result which is fairly satisfactory. It may be noted that certain slender iron railings on the top of the house to our left are sharply defined.

Fig. 23. **Malden.**—8 a.m. Aug. Sun. $6\frac{1}{2}$" stigmatic lens. Ortho plate. 6 times screen. *f*/16. Exp. 1". This is an instance of a landscape or general view taken across a sheet of water, so that any thought of approaching the subject along the line of sight is out of the question. The chief feature of interest is the church and the cottages grouped round it. There is little or nothing of pictorial interest in this print. It suffers from overcrowding too many small and distant objects into the picture space. The clouds are in the original negative, but their composition is not particularly suitable, though their forms are interesting.

Fig. 24. **Malden.**—8 a.m. Aug. Sun. Telephoto combination by adding a negative lens to the above stigmatic lens, giving a magnification of about $4\frac{1}{2}$ times linear. The same ortho plate and screen used in both cases. The square of $4\frac{1}{2}$ is practically 20; so that had the same stop (*f*/16) been retained, the equivalent exposure should have been 20 sec., but the *f*/16 was changed for *f*/8 in the stigmatic lens, necessitating an exposure of one-fourth, or 5 seconds. It is interesting to note that the small part of the previous picture thus enlarged has a much greater pictorial interest. This is by no means always the case in telephotography. The small cottage down by the waterside shows the extremes of tar and whitewash. A very slight degree of general softness of definition was intentionally introduced, and seems to be advantageous.

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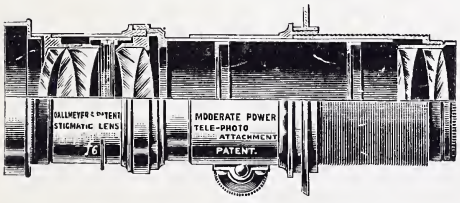

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The "LEDON" REFLEX with full-size finder and focussing eyepieces.

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First and Foremost our very, very hearty thanks are due to all our many friends and correspondents who have most kindly sent us words and cards of greeting. These have reached us from all parts of the globe, and have food for 'Kind Remembrance' that we shall never forget. Once more our hearty thanks to one and all.

The Bromide Monthly brings to a conclusion (in the Dec. number) its excellent series of chapters on photography in natural colours and gives as frontispiece a set of three monochrome prints illustrating the differences of negatives through blue, green and red filters.

Wellcome's Photographic Exposure Record and Diary for 1906 again makes its welcome appearance. Several revisions have been incorporated which tend to make the book still more useful and complete without in anyway adding to its bulk. The price, as heretofore, is One Shilling, and a very good shilling's worth it is.

All about Enlarging is the title of a Sixpenny Booklet written by our esteemed contributor, C. Winthrope Somerville, and published by Marshall, Brooks & Chalkly, in their "Focus" Manual Series. The author, from first to last, deals with his subject in an eminently practical manner and in language commendably concise. The book is divided into twelve chapters, which facilitates ready reference. While we hesitate to endorse the two first words of the title of this book, we have no hesitation in giving it our hearty commendation.

From Messrs. Beck (Cornhill) we have received a leaflet describing a special focal-plane Reflex hand camera for Beck-Steinheil Lenses. We have not yet had an opportunity of seeing the camera itself, but from the pamphlet we gather the impression that it appears to be an instrument designed with the utmost care. Every practical point seems to have been thoughtfully considered and provided for. It is difficult to imagine any person who could fail to be pleased with this camera fitted with a "*Beck-Steinheil*"—a lens so deservedly well-known and esteemed as to need no more than mere mention.

Messrs. Wellington & Ward send us another of their many tasteful pamphlets. This time it is a price list and almanac combined, and embellished by a series of monthly tableaux giving the amusing adventures of Alphonso, Belinda, and Ye Wise Cat.

The Page Croft Pigment Paper.—Just at the moment of closing our pages for the press we have received from Mr. Page Croft (24, Quadrant Chambers, New Street, Birmingham) some samples of a pigment paper that he is putting on the market, and also some admirable examples of his work with this paper. These show us that the paper is capable of yielding the *finest details* of a line drawing and also *broad and soft effects* with great delicacy and richness. We are impatiently looking forward to experimenting with the samples and hope to record our results at an early date. Mr. Page Croft is a past master in pigment (or gum-bichromate printing, as the more familiar term has it) and those of our readers interested in these matters should send to him for a descriptive leaflet, and at the same time not fail to mention *The Practical Photographer*.

The Rotary Co., Ltd., desire us to say that their Mr. C. E. Hodges is starting on an extended tour of the Colonies, Egypt, India, etc., carrying samples of all the many admirable goods of this firm.

From Messrs. Houghton (High Holborn) we have received a sample of their Sulphide Toning Cartridges (Ensign brand) and also a pair of toned and untoned sample prints. The colour of the toned print is that warm brown which so well suits a large number of landscape, figure and portrait pictures. The preparation is very conveniently put up in a glass tube, capsule, or cartridge measuring about 2½ inches in length. This contains an orange powder and also a considerably smaller but similarly shaped glass tube which in turn contains some white crystals. The orange powder is dissolved in 5 oz. of water. In this solution the print is bleached and washed. The white crystals are dissolved in another lot of 5 oz. of water and the print therein immersed when it turns to a rich brown. It is then again washed and dried. These cartridges cannot fail to meet with a wide and welcome reception.

From Messrs. Kodak we have received an imposing volume entitled "The modern way in picture making"—published as an aid to the Amateur Photographer. (Eastman Kodak Co., Rochester, N.Y. 4/-). As this work differs somewhat from all other books on Photography we venture to quote from the preface as follows:—"Our first object in the publication of this book is to make photography easier for the amateur. Our second is to show him the new way to new pleasures in picture making." "Frankly we have given the preference to work by the Kodak system." "While we have given prominence to the Kodak method of work we have nevertheless recognised the fact that there are those who, by choice or because they have other apparatus than ours, still cling to the use of glass plates, and we have accordingly applied the instructions to the whole broad field of amateur photography." The 190 pages of the book abound with information and instruction on practically all the everyday branches of photography *e.g.*, Landscape, Portraiture, Flashlight, Winter Photography, Flowers, Birds, Fish, Composition, Clouds, Enlarging, Stereoscopic Photography, Lantern Slides. It goes without saying that ample instruction is given on such matters as exposure and developing, while the printing methods explained include Velox, Dekko, Azo, Solio, Kloro, Aristo, Mezzotone, W.D. Platinum, Ferro-Prussiate, Gum Bichromate, Plain Silver Paper, Carbon Printing. Failures in the various procedures are discussed. Ample formulæ are given. The book is very generously illustrated by examples from such well-known men as Stieligtz, Dugmore, Eickmeyer. Altogether it is a book which cannot fail to please both the tyro and expert, and we strongly commend it to our readers.

Notices.

We have received **Penrose's Pictorial Annual**—better known perhaps as The Process Year Book—and find it rather larger than ever. The Editor may be congratulated on having got together a generous menu of interesting technical matter and a surprising variety of examples of the art of block-making. The one point which strikes us as open to improvement here as elsewhere when process blocks are used, is in the matter of a greater variety of quieter shades of inks, such as sepia, warm black, cool browns, and the like. The printers (Percy Lund, Humphries & Co., Ltd.) may be heartily congratulated on having produced a book in their best style. Every process worker and photographic society should certainly possess a copy of The Process Year Book.

The British Journal Photographic Almanac once again makes its timely and welcome appearance, and is a little bulkier than ever. It seems to us that the time has now fully come when the Editor might advisedly omit the comparatively small collection of disconnected articles and make the book a yearly volume of reference matter pure and simple, including, of course, an epitome of progress in the various departments of present-day photography.

We can speak from a personal experience of the British Journal Almanac extending over a period of something like a quarter of a century, and have more than one lively recollection of wearisome searchings for some of these short articles, which would have been far more appropriately and conveniently located in the columns of a weekly or monthly journal.

Mr. Tylar has sent us a sample of his Togo Developer, a preparation in two bottles for developing Gaslight Papers, Bromide Papers and Dry Plates.

The Camera House Journal issued by Messrs. Butcher continues its career of usefulness and general go ahead character. It is an enterprising "Business Bulletin," which all dealers should possess.

Messrs. Watson (High Holborn) inform us that they are now supplying their well-known Antinous Shutter Release for use in connection with the Spido Camera, and will also in a few days be prepared to supply a form suitable for the Verascope.

One and All Gardening is the title of a booklet published by the Horticultural Association, 92, Long Acre, price 2d. It abounds with all sorts of useful information on gardens, useful and ornamental.

Exhibition. Canterbury Camera Club. Open classes. Entries close Feb. 10. Hon Sec., W. Guard, St. Dunstan's, Canterbury. Judge: Editor, *Practical Photographer*.

Exhibition. Dover Photographic Society. Open classes. Feb. 14. Hon. Sec., J. W. Howells, 6, Gladstone Terrace, Dover. Judge: Editor, *Practical Photographer*.

Prints for Criticism, etc.

Will competitors and others please kindly note our rule to the effect that when prints are to be returned stamp must be sent **WITH THE PRINTS**— *not afterwards?*

Will contributors to our various competitions kindly refrain from sending under one cover prints for different competitions? This not only gives us considerable trouble, but involves the risk of the various pictures not being properly entered for the competition for which they are intended. It is far better for all concerned to send each lot of prints in separate parcels.

Will competitors also please bear in mind that the prints received during the month cannot be judged till the last day of the month, and that as we go to press about the 20th of the month it is not possible to criticise prints in our issue dated the month next to that when the prints were sent in?

R. M. (Grangemouth).—We are glad to find that our hints have proved useful to you, as some of those who ask for criticism really only want undiluted praise and flattery, which is perhaps the very worst thing possible for anyone who is honestly trying to make progress. For after all it is the experience one gets from making mistakes and then learning how to avoid them that proves to be the greatest help in time of difficulty. (1). The point which first strikes us is that the sky and land line in the distance is a little too sharply defined and cuts up many of the branches of the trees in an unfortunate manner. Try the effect of a little judicious softening of this line all the way along, aiming that it will lose itself (as painters say) in the part where it runs behind the mid-distance trees. Of course, these hints will suggest to you that the reflection of this line in the water should in a like manner be slightly subdued. The reflection light in the water also might with advantage be rather reduced in size by darkening the portion nearest to the left-hand margin. (2) This picture is what one might call just a little lumpy all over. The cloud forms in this are interesting, but require a little drawing together. You have too many patches of approximately the same size. Next, the white cow in the centre of the picture is just a little too patchy white and must be very cautiously and slightly subdued. At present it seems to dominate everything else in the picture rather than to be a part of it.

J. C. (Campbeltown).—In both your prints we notice the same tendency, namely, that of a lack of sufficient half-tone. One may roughly compare them to a tune played on a piano with one's hands at opposite ends of the keyboard. The darker portions of No. 2 are all good in themselves, but what we want here is much more gradation, from the highest lights in the distant water down to the lighter tones on the wet shore. The sky also wants more suggestion of cloud and atmosphere. Print 1 is all right as regards the land in the middle distance part, but your nearer rocks are here too uniformly dark and the large patch of water in the middle is too uniformly light, so that at both ends of the scale we want a good deal more gradation. Evidently your negatives are a little too hard, that is to say, strong in contrast (probably due to carrying development too far) for easy success in enlargement. For this purpose a negative is best when slightly inclined to thinness.

O. W. F. T. (Coalville).—As a piece of technical work this is distinctly creditable. Your rendering of the windows speaks well for the quality of the plate. The carving also on the panels comes out admirably. Pictorially you no doubt feel with us that this is a subject which calls for a little suggestion of the local colour of the scene itself. This is just where photography fails. Then again we feel in a case of this kind the need of being able to put ourselves further away from the subject so as to get a less strongly pronounced perspective effect. We think you have made rather a mistake in the choice of this strong maroon red inner tint, especially when it is used in addition with its complementary colour (green), and thus becomes emphasized.

A. G. W. (Palmer's Green).—There is something not entirely satisfactory in this picture, as it does not adequately give us the suggestion of warm summer sunshine. We rather fancy that the exposure has not been quite sufficient to give gradation in the darker portions, and that the negative has been a

little over-developed, as the high-lights have lost some of the delicacy of gradation also. Without seeing the negative itself it is very difficult to suggest what is best to be done. We certainly feel that you are more likely to get a more harmonious result from this negative by the use of as rough a transfer paper as you can find. It would also help the composition considerably if you would remove from the left-hand side about $\frac{3}{8}$ in. and rather more than this from the right-hand side, and about $\frac{5}{8}$ in. from the lower margin. This would give you a little better balance of composition. We would also suggest that you should use a tissue not quite so pronounced in colour; a warm black or a cool brown would be more likely to suit the subject.

F. D. (Weston-super-Mare).—In the three prints you send us you have not been very happy in the expression of your figure in any one case. In Nos. 7 and 8 it is a little unfortunate that you have cut away the dog's feet. This has not a very good or pleasing effect. In both these cases, also, the "victim" has an expression which is anything but flattering to the photographer. Print 9 is, on the whole, the best of the three; but here, again, there is something not quite satisfactory about it. It looks as though the sitter were putting on a special expression for the purpose, and that this expression would require a considerable effort to maintain, and is, therefore, not wholly natural. The general effect of the large space of white taken up by the blouse rather tends to take too much attention away from the face.

W. R. (Wigan).—(1) The rendering of the sky and cloud portion is quite excellent, but your print is very weak along the left margin. This part looks as though fog of some kind has found its way in the plate. At any rate there is nothing now for it but to remove just about $\frac{1}{2}$ in. from this side. In your next print use a rougher surface paper and do not carry development quite so far. The nearer portions of foliage on the left side are a trifle too dark. (2) Technically this is a really very creditable piece of work. Pictorially it wants the addition or suggestion of a little cloud or, at any rate, atmospheric softening of the sky part, as no doubt you have seen for yourself. Although the figure on the bridge is small, still it would have been better had she been omitted. (3) Here, again, your sky part is very good, although you have carried development of the print just a little too far. The whole scene is too suggestive of moonlight rather than bright daylight. Try another print with about the same exposure, dilute your developer with at least an equal bulk of water and stop development as soon as the details in the lighter portion of the sky are just visible. Then wash and fix at once. With a little care you might get a very much better print from negative No. 3.

E. C. (Norwich).—1. We like the general arrangement and composition of this picture very much. Our chief fault to find with it is that the colour is too assertive. We seem to see the colour before everything else, whereas for monochrome work all one wants in colour is a mere suggestion so that one does not see any particular colour until the mind is deliberately turned to that question. 2. In this instance you err on the side of excessive darkness in the land part generally. The sky and cloud portion is excellent, but the rest quite untrue in tone. Both your prints are suggesting to us that you are tending to under-exposure and then carry development too far so that your negatives are too hard and contrastful. We note you are using Pyro-Soda. Possibly your developer is leaving behind it a slight yellow stain which has a very material effect in printing, especially in the case of artificial light printing. We strongly recommend you to make one or two experimental negatives which shall err on the side of slight over-exposure and shall not be over-developed.

A. H. T. (Godalming).—Your print requires a little more careful and vigorous trimming, so that your edges shall not show the remnant of white margin. Then your mounting paper must be first of all pasted down to a piece of stout card and then allowed to get nearly dry before the print is placed on it' so that you may avoid the cockling as in the case of your present picture. Technically your print is distinctly creditable and the point of view is also very tastefully chosen. The sky requires just a very slight sunning down in the upper portion so as to suggest a little gradation and atmosphere. The print now before us certainly does not do anything like justice to your negative. We specially commend to your notice Volume No. 4, which deals with those finishing touches which are so helpful in the final stages of the print.

H. S. P. (Bradshaw).—Your little picture is very very nearly being quite a charming success, but where it falls off is in the darkest portions of your figure merging into the background without any differentiations. By all means try again and set up a large clothes-horse, three or four feet away behind the figure and over the clothes-horse throw a sheet or table-cloth, or pin up sheets of white paper so as to act as a diffuser and reflector. The difference this will make will surprise you greatly. We shall be interested to see your result.

Miss M. (Kirkby Stephen).—This print is a little too feeble and weak generally. One seems to want a little more vigour and strength in the nearer part if you can possibly manage to introduce it. Then again it is a little unfortunate that the lines of the tree trunks all seem to be tilting over slightly towards the right-hand side of the picture. Then again one feels that the trimming is not quite correct. At any rate it would be worth while trying to correct this general impression by a little alteration of the angles of the print. The suggestion of cloud is quite excellent and the rendering of the distance also is charmingly soft and tender. What one wants is just a little more vigour in the light and shade of the nearmost portion and the nearmost tree, and the cart track over the field.

A. R. B. (Bucknell).—We are much pleased with the general effect of your print No. 1, though it was just a little lazy on your part not to trim it before sending, as the untidy margins which it has at present are anything but in its favour. When trimming we would advise your removing about § in. from the top part of your picture. This will give a better general shape. The next print might, with advantage, be kept just a suspicion lighter, as your sky is now too dark and solid-looking. Print 2 is not quite such a success. The near part of the roadway is too wide compared with the more distant portion. This is the result of a lens of a somewhat short focal length. The remedy now is to trim away, let us say, half an inch from the lower portion of your picture. You must also introduce a little suggestion of sky from some other suitable negative. The present blank sky certainly will not do as it is. The light and shade contrasts in the nearer portions of the roadway might be slightly softened by cautious retouching, but this must be only very slight indeed. (3) Here your contrasts are too strong generally, and, except for the bit of distance, your picture is too black and white to be satisfactory. Again the sky part must have very careful attention, and be toned down generally from above downwards. Probably you would get a better and more harmonious result by printing this negative in platinum rather than bromide.

E. T. R. (West Cranlington).—It is not quite easy to see how your title applies in this case, as there is a little confusion between the two figures. The mother's hands seem to come too dark relatively, but all else is technically very creditable. We do not care for the warm red colour of the print itself. It is a very interesting example of artificial light work. The hands already referred to might be kept back in the printing by coating this portion on the back of the negative with ground-glass varnish. A little holding back would be sufficient. Your mounting is very neat, excepting that the outside paper is too flimsy. This should have been strengthened by pasting it down to stout card.

F. A. T. (Sheffield).—We notice this time that you have sent your prints in a rather different style of mounting. All things considered we are inclined to advise you not to adopt this style as it is calculated to compete with rather than help forward the feeling and sentiment of your pictures. We prefer the quieter style of plain monotone papers well backed up with some stout card. 1. This we like best of your three studies this time. Apart from its mount we should say that it merely wants a little more suggestion of difference of light and shade in the sky than you have at present. A very little subduing of the upper part of the sky would be sufficient. Of course you understand that this toning down should be *very* gradual from above downwards. 2. Here the strongly pronounced colour of the wooden mount seems to upset our judgment, but covering up this we see really a very charming little study which simply wants a little more vigour or contrast of light and shade in the nearer portions so as to give better relative value to the evening effect of the

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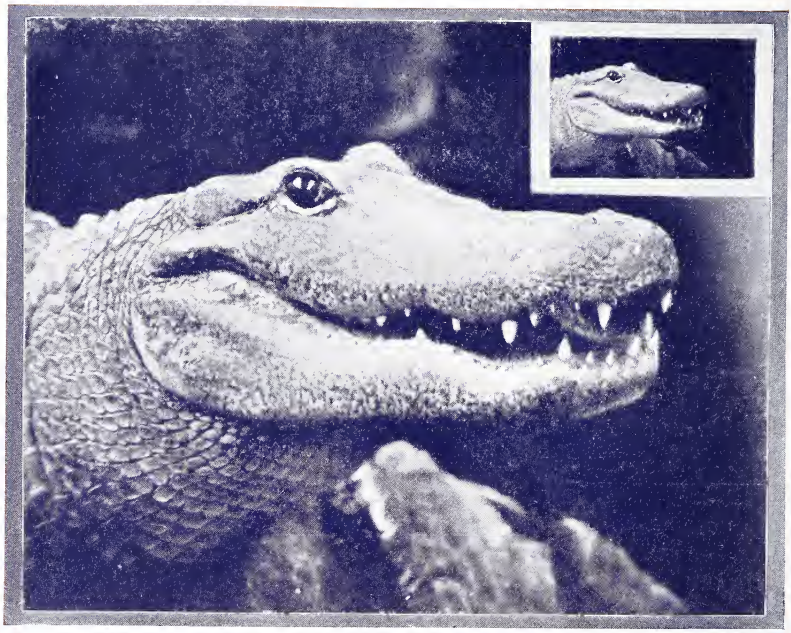

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A1	48	grosvenor green	**A01**	32
A2	48	duffel gray	**A02**	32
A3	48	gray bark	**A03**	32
A4	48	playfield cream	**A04**	32
A5	48	rough white	**A05**	32
A6	48	dove	**A06**	32
A7	48	deep sea blue	**A07**	32
A8	48	autumn brown	**A08**	32
A9	48	smoke gray	**A09**	32
A10	48	fern green	**A010**	32
A11	48	coffee	**A011**	32
A12	48	wine red	**A012**	32
A13	48	black	**A013**	32
A14	48	olive green	**A014**	32
A15	48	iron gray	**A015**	32
A16	48	russet	**A016**	32
A17	48	slate	**A017**	32
A18	48	drab	**A018**	32
A19	48	brown	**A019**	32

To take sizes up to ½-plate.

Ordinary Thickness. No.	Contains sheets 10×8 in.		Extra Thick Series. No.	Contains sheets 10×8 in.
B	36	assorted colours	**B0**	24
B1	36	grosvenor green	**B01**	24
B2	36	duffel gray	**B02**	24
B3	36	gray bark	**B03**	24
B4	36	playfield cream	**B04**	24
B5	36	rough white	**B05**	24
B6	36	dove	**B06**	24
B7	36	deep sea blue	**B07**	24
B8	36	autumn brown	**B08**	24
B9	36	smoke gray	**B09**	24
B10	36	fern green	**B010**	24
B11	36	coffee	**B011**	24
B12	36	wine red	**B012**	24
B13	36	black	**B013**	24
B14	36	olive green	**B014**	24
B15	36	iron gray	**B015**	24
B16	36	russet	**B016**	24
B17	36	slate	**B017**	24
B18	36	drab	**B018**	24
B19	36	brown	**B019**	24

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Ordinary Thickness. No.	Contains sheets 12×10 in.		Extra Thick Series. No.	Contains sheets 12×10 in.
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C1	24	grosvenor green	**C01**	16
C2	24	duffel gray	**C02**	16
C3	24	gray bark	**C03**	16
C4	24	playfield cream	**C04**	16
C5	24	rough white	**C05**	16
C6	24	dove	**C06**	16
C7	24	deep sea blue	**C07**	16
C8	24	autumn brown	**C08**	16
C9	24	smoke gray	**C09**	16

To take sizes up to ½-plate.

Ordinary Thickness. No.	Contains sheets 12×10 in.		Extra Thick Series. No.	Contains sheets 12×10 in.
C10	24	fern green	**C010**	16
C11	24	coffee	**C011**	16
C12	24	wine red	**C012**	16
C13	24	black	**C013**	16
C14	24	olive green	**C014**	16
C15	24	iron gray	**C015**	16
C16	24	russet	**C016**	16
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C18	24	drab	**C018**	16
C19	24	brown	**C019**	16

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mist or haze in the distance. At present the haze is too much all over the picture. 3. This we do not regard as quite so successful. The sky is much too light and the group of figures are rather confusing, that is to say, their number is too great and they are too much mixed up one with each other. We did not realize what the object in the water is for some little time.

Miss W. (Corwen).—1. This is a tasteful and very pleasing composition. Our only fault to find with it is in the distance. The sky line of the land against the sky is too sharp and hard, and the distance is a little too dark. The very distant hill should be a shade lighter, and the sky here and there just a suspicion darker. 2. Although this is not so good a technical result as No. 1, yet it is the more pictorial of the two, inasmuch as the general arrangement of lines and masses comes better. The figures are just a trifle stiff in their pose, but something may be allowed to them on account of their youth. The print is too black and white generally. Your remedy is to use a cream-toned crayon paper bromide, to give a very generous exposure, dilute the developer with at least an equal bulk of water, and aim at getting a much softer result. For this purpose you will find metol perhaps the most serviceable. The upper part of this print to the extent of about one inch might advantageously be removed. This would help to concentrate the interest round the figures.

J. H. S. (Leeds).—Although the subject is not particularly picturesque, yet you certainly have made the best of it, excepting that your architecture is apparently suffering from a severe shock of earthquake, as the buildings are tilting over in a most alarming manner towards our right hand. You must carefully correct this in another print; it is a matter of the utmost importance. We should like to see another print on a decidedly rough surface paper, with the development not carried quite so far, so as to give a slightly gray and softened effect throughout. If you could at the same time get a little more gradation in the foreground snow, this would immensely help matters.

C. D. (Brighouse).—We are very pleased to recognise the promising character of your work. The best study is No. 3. With this we have but very little fault indeed to find, namely, that the print is rather too red in colour to harmonise with the subject. We should have preferred the colour a shade more brown. Be careful that you do not write your titles so large or strongly as to attract too much attention. 1. This shows us an interesting example of a very curiously constructed porch. The subject is not so much pictorial as of architectural interest, and you have done your share of the work very creditably. Here again your titling is taking up a little too much attention. You must get it a little simpler and less noticeable. (2). As regards arrangements of light and shade this is the best of the three, but the point of view shows the arch rather too full-face and the distant portion seen through the arch does not look quite distant enough, that is to say the picture is just a trifle lacking in relief. All three are excellent examples of careful technical work.

A. J. (Bristol).—You will find that our contemplated improvements in the *Practical Photographer*, which we have in hand will come very near to your suggestions. The out-of-print numbers are now fetching from three to five shillings each according to condition. You had better fill your gaps while you can, as there are several other numbers practically exhausted.

J. J. (Leeds).—Damp the cardboard with a sponge and let it expand before putting on the mount paper. Look up the subject in our number 4.

J. H. S. (Royston).—It is worth something extra to have a first-class name like A, or B, on a lens. You may rely upon anything that either of these firms put their names on as being thoroughly efficient.

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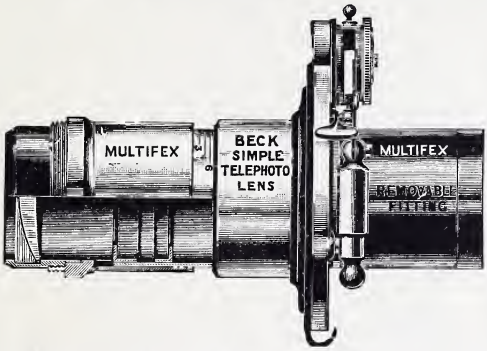

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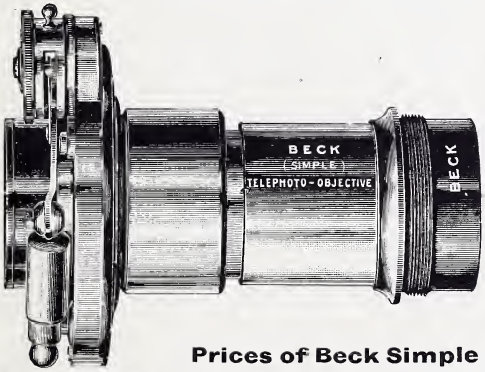

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